THE DEVELOPMENT OF AN INDEX TO ASSESS COMPUTER ANXIETY

by

JO B. BROOKE

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Jo B. Brooke

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The purposes of this study were to develop, refine, and field test the Computer Anxiety Rating Scale (CARS), and to determine its validity and reliability for use with college students. The 30-item CARS measures anxiety toward microcomputers, may be administered individually or in groups, and has a seventh-grade reading level.

The CARS was field tested with students in three academic colleges at both a private and a public university in Florida. Data were collected initially from a sample of 256 students. Following preliminary factor analyses, the revised instrument was used to collect data from a second sample of 355 students. Demographic data were collected regarding age, gender, academic major, and amount of computer experience on five experience variables. The CARS was found to have four factors (Comfortability, Enjoyment, Security, and Rationality) and

excellent reliability for the full scale. Word processing experience was found to be the best predictor of computer anxiety, regardless of age or gender. Also, age was negatively related to computer anxiety, and females scored significantly higher in computer anxiety than did males. Business administration majors scored significantly lower in computer anxiety than either arts and science or education majors.

Separate subsamples also completed Spielberger's State-Trait Anxiety Inventory, Suinn's Mathematics Anxiety Rating Scale, Spielberger's Test Anxiety Inventory, and Rotter's Internal-External Locus of Control Scale. Computer anxiety was significantly related to trait and mathematics anxiety, but not to test anxiety or locus of control.

It was concluded that the CARS is an effective measure of computer anxiety. Computer anxiety, similar to test anxiety, was found to be a specific manifestation of general anxiety. Further research is needed to determine the suitability of the CARS for use with other populations and to clarify gender-based differences in computer anxiety. The CARS should be useful in counseling and other computer anxiety reduction activities and related research.

CHAPTER I

INTRODUCTION

> As the Industrial Revolution augmented the muscle power of humankind, the Computer Revolution increased the mind power of humankind. In the past half-dozen years, however, there has been a second computer revolution, marked by the coming of the microcomputer. (Winkle & Mathews, 1982, p. 314)

The age of the computer is upon us. Our lives have been transformed by the silicon chip and by the promises made on its behalf to teach us to read, to balance our checkbooks, to file our recipes, and to play chess with us while it keeps track of our taxes. The pervasiveness of the computer is so great in our lives that it has been estimated that by 1990 75% of the workforce in the United States will use a computer daily (Rodenstein, 1983).

In his book <u>Megatrends</u>, Naisbitt (1982) predicted that as early as 1985 75% of all jobs would involve computers in some way. Toffler (1980), in <u>The Third Wave</u>, wrote that home computers will become as common as indoor bathrooms or television sets. Probably no innovation in the last several decades has had the power and potential of the computer to affect so dramatically the ways we live.

The current tendency is to concentrate attention (e.g., in the media) on the many impressive, positive capabilities

of computers. However, the often overlooked fact is that the computer also has negative capabilities--one of which is the generation of emotional resistance. As Gelatt (1984) noted, "Humans invent tools and design machines. In turn, tools and machines shape and change humans" (p. 133). The emergence of computer technology, in particular the evolution from large, centralized "mainframe" computers to smaller, "personal" microcomputers, has led to increased concern about emotional reactions to computer technology. Therefore, in recent years, several writers have attempted to create and define the construct of "computer anxiety."

The adult population of the United States has for some years experienced "math anxiety" as a common phenomenon. However, unlike reaction to mathematics (to which most adults have been exposed since early childhood), the computer poses a very different challenge to the emotions. Anxiety regarding computers typically cannot be related to negative experiences in the early educational years; indeed, adult responses are often "compounded by witnessing children who undauntedly take to the computer as they did to tv" (Widmer & Parker, 1983, p. 23).

A second distinct manifestation of anxiety that has captured the attention of educational researchers is that of "test anxiety." Studied systematically for over thirty years, test anxiety has been found to be a pervasive problem on college campuses (Cambre & Cook, 1985). Some researchers

have proposed that computer anxiety is comparable to both math anxiety and test anxiety as a situational manifestation of a general anxiety construct, and that it appears to stem from a traditional source of anxiety: fear of the unknown, and the psychological stress that results from a perceived personal threat from the unknown.

Recent studies have offered conceptual definitions of computer anxiety as well as operational definitions of it derived from the general literature on anxiety. The conceptual definitions have focused upon both psychological and physiological reactions to working with computers. The operational definitions have been offered to undergird measurement of computer anxiety. For example, at least three studies have focused upon development of indices of computer anxiety. Subjects used in these studies have included college computer-science majors, teacher education majors, students in introductory psychology classes, and other relatively specific groups of college students. Therefore, although there have been attempts to develop measures of computer anxiety (i.e., to provide a means to quantify it), these efforts have been limited from several important perspectives. Consequently, this study evolved from the gap that existed between establishment of a construct of computer anxiety and the development of a valid instrument to measure it effectively, and to do so using stringent sampling procedures.

Overview

According to Rohner and Simonson (1981), people who are "computer resistant" and/or "anxious" most likely will not choose to interact with a computer. As a result, choices are made to avoid opportunities for computer use, literacy, and hands-on experience in the educational world, the job market, and in personal life. One of the fears (i.e., anxieties) of the "uninitiated" to computers seems to be that computers will "take over our lives, that they will dictate what we do and how we do it" (Gelatt, 1984, p. 134). Resistance to innovation and change has been a continuing and particular problem in the field of education. For example, Rohner and Simonson (1981) cited studies demonstrating continued resistance to creative incorporation of computer technology among teachers in the classrooms, in spite of readily available computer hardware and software.

Industrial consultants, such as Poppel (1980; cited in Baumgarte, 1984) have estimated that a third of persons in information management positions also react warily to computers in the work setting. Challenged by the unfamiliarity of electronic technology, and the feeling of responsibility for learning a difficult task formerly assigned to clerical staff, employees tend to avoid or resist computer terminology and use.

Anderson (1983) wrote that among the general public many people are "making an effort to educate themselves (about

computers), but are intimidated, whether or not they openly admit it. Intimidation, with its long time partner, fear, are extremely effective blockers of learning" (p. 114).

Technological changes in the workplace have affected, and continue to impact, vocational counseling in particular. Further, these same changes generate pressures within the counseling profession at large. Just as audiotaping by Rogers in 1942 (cited in Goodyear, 1984) modified the entire field of counselor training and supervision, as well as understanding of the counseling process, the infusion of computers is generating the need for changes in preparation standards for counselors. For example, Sampson and Loesch (1985) made a strong argument for inclusion of computer applications training in future standards of preparation for the counseling and human development professions.

It has become increasingly clear that introducing computers into any setting involves more than purchasing equipment. Personal computers can change the nature of relationships and the definitions of tasks. Theoretically, a computer may be regarded as neutral, but its implementation and use are not.

Some effort has been made to predict negative attitudes toward computers. Coovert and Goldstein (1980), for example, found that persons with an external locus of control were more likely to express fear about using the computer than persons with an internal locus.

Wilson and Rotter (1982; cited in Gelatt, 1984) wrote that for the child born today, 97% of what is known will be discovered in his or her lifetime. This voluminous information cannot be comprehended and/or used effectively by limited human memory systems or "filing cabinet" approaches to information storage and retrieval; computers are increasingly becoming essential for information management purposes. Therefore, as instruments to collect and manage information, to assist in decision-making, and to speed learning, computers continue to gain in importance. Just as an increasingly complex world requires at least basic skills in reading, writing, and math, so it also places a premium on at least a minimum of computer knowledge as an integral part of daily living.

A primary objective of the counseling profession is to facilitate solution of the problems experienced by the persons it serves. Avoidance and fear of computers in a rapidly developing "computerized society" promise to become increasingly recognized problems. As computer technology increases its influence, both positively and negatively, the response of the counseling profession must be multifaceted. Therefore, in this study, a mechanism was developed to measure computer anxiety effectively and thus allow identification of and ultimately assistance to computer-anxious persons.

Need for the Study

Walsh and Betz (1985) defined assessment as a process of understanding and helping people cope with problems. In an applied sense, the assessment process includes defining a problem, gathering information about a person, and properly interpreting the information, and then solving the problem. In this context, the development of an index to measure computer anxiety was necessary to provide potentially useful information in the areas of theory, training, research, and practice. For example, counseling theory regarding specific manifestations of anxiety has been refined through development of the instrument and may be further refined through its use. Further, counselor preparation programs have a resource available to assess computer anxiety and thus are aided in training professionals. The instrument also may be helpful in research to measure the effectiveness of counseling interventions (e.g., computer anxiety reduction), as well as to determine the extent of computer anxiety.

In the practice of counseling, professionals will be able to use the instrument to assess the extent of a specific anxiety and to guide their clients in achievement of more beneficial responses to it. As society becomes increasingly more complex, so do the emotional responses of persons living and coping in society. The potential for benefit and wide practical utility in the counseling profession therefore can

be realized by an instrument that has been developed thoughtfully, thoroughly, and ethically.

Purpose of the Study

The achievement of the ability to assess computer anxiety required the development of a suitable measuring instrument. Prerequisite to such a development was the establishment of computer anxiety as a valid psychological construct, including a clear definition of what was to be measured. Instruments available at the time of this study assessed specific anxiety reactions such as those to math and to test-taking (Cambre & Cook, 1984), but lacked valid specificity for the measurement of computer anxiety.

In a study by Powers, Cummings, and Talbott (1973), indirect responses from subjects regarding fears or attitudes toward computers were measured; however, those responses were not cross-validated against other variables or measures. Jordan and Stroup (1982) also investigated computer fear and attempted to discriminate individual characteristics of students who reported being (computer) fearful and those who did not. However, again, the methodology used greatly restricted the generalizability of the results. Therefore, there was need to conduct a study which directed particular attention to both measurement and sampling considerations.

Raub (1981), Rohner and Simonson (1981), and Maurer and Simonson (1984) have provided conceptual definitions of

computer anxiety. Unfortunately, Raub reported no reliability data on the assessment used and had as subjects only students in introductory computer-science and psychology classes. Rohner and Simonson similarly initiated efforts to develop a measure of computer anxiety and to relate it to selected variables. However, the subjects selected in their study included only students in educational media classes. Following Rohner and Simonson, Maurer and Simonson revised the instrument they had used in an effort to overcome its perceived limitations, to validate it, and to set norms for the new form. However, the sampling procedures used in Maurer and Simonson's study were not conducted systematically.

Previous to this study, no available instrument had been developed to be fully suitable to the measurement of computer anxiety in a general population of college students. Therefore, this study undertook the development of such an instrument, called the Computer Anxiety Rating Scale (CARS). The specific purposes of the study were to develop, refine, and field test the instrument, and through this process to determine the extent to which computer anxiety could be reliably and validly measured.

Research Questions

This study addressed the following research questions:

1. What is the factor structure of the CARS?
2. What is the reliability of the CARS?

3. What is the relationship between the subject variable of age and computer anxiety as measured by the CARS?

4. What is the relationship between the subject variable of previous computer experience and computer anxiety as measured by the CARS?

5. What is the difference in computer anxiety as measured by the CARS, on the basis of the subject variable of gender?

6. What are the differences in computer anxiety as measured by the CARS, on the basis of the subject variable of academic major?

7. What is the relationship between computer anxiety as measured by the CARS, and trait anxiety?

8. What is the relationship between computer anxiety as measured by the CARS, and math anxiety?

9. What is the relationship between computer anxiety as measured by the CARS, and test anxiety?

10. What is the relationship between computer anxiety as measured by the CARS, and locus of control?

Definition of Terms

For purposes of this study, the following definitions were used:

Anxiety is a psychological construct whose theoretical definition still defies consensus. Its most common definition is the one provided by Spielberger (1966) who defined it as

being of two types: a personality characteristic (trait anxiety) and a transitory emotional state (state anxiety). Epstein (1972) defined anxiety as a state of diffuse arousal following the perception of threat, or alternatively, as unresolved fear. It was described by Philips, Martin, and Meyers (1972) as the result of psychological stress, brought about by threatened deprivation of an anticipated satisfaction, or as a result of uncertainty.

Trait anxiety is a unitary, relatively stable and permanent personality characteristic (Cattell & Scheier (1961). Spielberger (1966) described it as "a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening, and to respond to these with A-state reactions disproportionate in intensity to the magnitude of the objective danger" (p. 17).

State anxiety is a transitory condition which fluctuates over time and treatment (Cattell & Scheier (1961). It was clarified by Spielberger (1966) as "subjective, consciously perceived feelings of apprehension and tension, accompanied by or associated with activation or arousal of the autonomic nervous system" (p. 16-17).

Test anxiety refers to "A proneness to emit self-centered, interfering responses when confronted with evaluative conditions" (Sarason, 1972, p. 383).

Math anxiety refers to "Feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematics problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551).

Computer anxiety is a situational manifestation of the general anxiety construct. Raub (1981) defined it as "complex emotional reactions that are evoked in individuals who interpret computers as personally threatening" (p. 9). It was also described by Maurer and Simonson (1984) as "the fear and apprehension felt by an individual when considering the implications of utilizing computer technology, or when actually using computer technology . . . the fear of interaction with the computer, even though the computer possesses no immediate or real threat" (p. 2). Rohner and Simonson (1981) characterized it as "the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (p. 551). For the purposes of this study it is defined as the tendency to experience unresolved apprehension or fear when anticipating interaction with a computer, as well as the tendency to experience exaggerated feelings of disorientation and uncertainty when interacting with a computer. It is also characterized by feelings of worry when considering the personal implications of interaction with a computer, as well as a tendency to personify the computer.

Locus of control is a concept developed by Rotter (1966) within the context of social learning theory to account for generalized expectancies for internal versus external control of reinforcement.

Internal locus of control refers to an individual's perception of an event as contingent upon his/her own behavior (Rotter, 1966).

External locus of control refers to an individual's perception of an event as not being entirely contingent upon his/her own action but the result of chance, fate, or luck, or under the control of powerful others (Rotter, 1966).

Computer is a term used to describe a general purpose machine with applications limited only by the creativity of the humans who use it; its power is derived from its speed, accuracy, and memory (Mandel, 1983).

Microcomputer refers to a very small computer; it is often a special-purpose or single-function computer controlled by a single microchip (Mandel, 1983).

Hardware refers to the physical parts of a computer (Mandel, 1983).

Software refers to the operating programs used to direct the computer for problem solving and overseeing operations (Mandel, 1983).

Overview of the Remainder of the Study

Four chapters comprise the remainder of the study. Chapter II provides a review of the literature related to various aspects of this study and to the construction of the CARS. The methodology used to develop, refine and field test the instrument is discussed in Chapter III. It also includes the results of a developmental study, sampling procedures, instrumentation, data analyses, and methodological limitations. Chapter IV presents the results of the study, including the results of a preliminary factor analysis of the CARS. Chapter V presents discussion of the results, conclusions and implications, and suggestions for further research.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Anxiety, as a psychological construct, has received professional attention primarily in the twentieth-century. It can be assumed, however, that the experience of anxiety is an intrinsic aspect of being human, for the theme of anxiety appeared in the first literary narrative, the Epic of Gilgamesh, believed to have appeared in Babylonia at the beginning of the second millennium (Spielberger & Sarason, 1975).

In his classic book, The Meaning of Anxiety, written in 1950 and later revised, May (1977) presented an analysis of the historical and cultural trends that have contributed to recognition of anxiety as a characteristic of modern times. As May suggested, references to anxiety have appeared in popular literature, anxiety has been addressed as a major sociological problem, and in a political sense, "free floating" anxiety has been brought into the spotlight by the appearance of the Atomic Age. World philosophers have written of the meaning of anxiety, and within the fields of counseling and psychology, countless books, papers, and studies have dealt with anxiety.

This review of the related literature provides selected commentary on the construct of anxiety and its measurement as a framework for understanding computer anxiety. Included is an historical perspective of anxiety, followed by a summary of a popular current theory of anxiety, and a review of anxiety measurement. Further, because test anxiety and math anxiety are specific manifestations of anxiety that have captured the attention of educational researchers over recent years, and are believed to be in some ways comparable to computer anxiety, a review of studies in those areas is presented. The concept of locus of control also is reviewed as a potential predictor of computer anxiety. Finally, studies directly related to the nature and measurement of computer anxiety are presented.

Historical Background

Although the 20th century has been called the "age of anxiety" by numerous writers (e.g., Levitt, 1967; Epstein, 1972; May, 1977; Spielberger, 1979), concern with fear and anxiety is as old as humanity. The concept of fear was clearly represented in ancient Egyptian hieroglyphics, and there were numerous references to fear in the Bible and in the writings of the early Greek and Roman philosophers (Spielberger, 1979).

Among the Greek writers there was (apparently) concern with a search for tranquility, or ataraxia. Spielberger and Sarason (1975) noted that this interest revealed a self-awareness that marked the end of more primitive times when

humans tended to classify themselves as part of a group and not as individuals. The classical Greek dramas contained many allusions to human feelings, some of which, although not called anxiety, can be recognized as such.

The Hellenistic period, beginning with the conquests of Alexander the Great, is considered a highly creative age but also an anxious and disturbed one. May (1977) suggested that during this period anxiety seemed characteristic of a time when humankind had lost its world, and stated, "I suspect that careful research would show that all times of rapid and unpredictable cultural change . . . always lead to heightened anxiety" (p. 7).

The earliest written recognition of anxiety as a determinant of behavior was suggested by Spielberger (1979) to be that of an 11th century Arab philosopher who proposed anxiety as a basic condition of human life and a prime motivator of human behavior. Much later, in the 1872 publication of <u>The Expression of Emotions in Man and Animals</u> (cited in Spielberger, 1979), Darwin also expressed belief that fear was a fundamental human emotion, necessary to arouse and mobilize humans and animals to cope with external dangers. Darwin described typical symptoms of fear to be rapid heartbeat, dryness of the mouth, increased perspiration, and dilation of the pupils. These and other physiological and biochemical changes were later studied by Cannon and Selye and characterized as the now familiar "fight or flight response" and the

"general adaptation syndrome" (Spielberger, 1979). Darwin reasoned that the characteristics of fear had evolved over countless generations through the process of natural selection.

Technological changes that took place during the 19th century, as well as rapid urbanization, contributed to many conditions which led psychologists to study what are now known as "psychological problems." Freud (1936; cited in Spielberger, 1979) was probably the first to make a distinction between the conditions of fear and anxiety. Freud regarded anxiety as "something felt," an unpleasant affective state or condition (Spielberger, 1966). First regarding anxiety as a purely physiological reaction, Freud later distinguished three types of anxiety he believed were psychological in nature. The first was <u>reality anxiety</u> (sensible and adaptive), followed by <u>neurotic</u> and <u>moral anxiety</u> (the troublemakers). <u>Primary anxiety</u>, felt by the infant perceiving the absence of its mother, Freud believed set the pattern early in life for all subsequent anxiety reactions (Levitt, 1967). Freud continued to modify his views on anxiety over a period of nearly 50 years as he persevered in searching for clarification.

Spielberger (1966) traced anxiety as a psychological construct first seen in Freud's identification of "angst" as a discrete clinical syndrome in 1894, through animal studies in the 1940s, to four major publications in the 1950s: May's

The Meaning of Anxiety; Mowrer's Learning Theory and Personality Dynamics; Anxiety, edited by Hock and Zubin; and Dollard and Miller's Personality and Psychotherapy.

Following Freud, clinical studies of anxiety appeared frequently in the psychiatric literature. In addition, after Pavlov's discovery of (so-called) experimental anxiety, numerous studies of fear, frustration, and conflict in animals appeared in the professional literature. The most commonly cited are Liddell's sheep in 1944, Gantt's dogs in 1942, Masserman's cats in 1943, and the rat studies of Mowrer in 1940 and Miller in 1948 (Spielberger, 1966). In 1950 May concluded that ethical considerations and real physical danger would prevent experimental studies on human anxiety, but his prediction proved false. From 1950 to 1966 more than 1500 experimental studies of anxiety in humans were published (Spielberger, 1966).

Mowrer, writing in the 1950s, proposed a "guilt theory" of anxiety and contended that anxiety comes not from future-oriented behavior, but "from acts which he [the individual] has committed but wishes that he had not" (1950; cited in Spielberger, 1966, p. 11). According to Mowrer, anxiety was neurotic and resulted from demands of the conscience and too much self-indulgence.

Introducing quite a different theory in the 1950s, Dollard and Miller published Personality and Psychotherapy (1950; cited in Fischer, 1970). Basing their formulations on

the theories presented by Hull, they believed that behaviors were best understood as being drive-impelled and that all learning is held to be a function of reinforcement. According to Dollard and Miller, fear and one particular form of it, anxiety, are important learned drives. Once anxiety is learned, it fosters creation of maladaptive behavior or conflicts. Dollard and Miller thus succeeded in translating Freud's principles of psychoanalytic theory into a conceptual framework of a stimulus-response learning system.

A decade later, Cattell and Scheier (1961) pioneered the use of multivariate statistical techniques in defining and measuring anxiety. Using as many as 325 different variables presumed to relate to some aspect of anxiety, "state" and "trait" anxiety consistently emerged as two principal factors. They hypothesized that it should be possible to measure both state and trait anxiety from a single personality questionnaire by applying different weights to each scale item.

In spite of the amount of anxiety research, there appears still to be a lack of consensus over its exact definition. Epstein (1972) suggested that the problem of defining anxiety might be similar to the problems that were experienced by the proverbial wise but blind men of Indostan who differed in their descriptions of an elephant. Nevertheless, several writers have attempted to synthesize various viewpoints.

In his summary of the work on anxiety, McReynolds (1975) identified two basic theoretical approaches to defining anxiety

found throughout the relevant historical literature. These approaches were categorized as either "cognitive orientations" or "conditioning orientations." The notion of the cognitive approach was that a person's anxiety resulted from psychological conflict, imbalance, or state of discrepancy occurring from thoughts, feelings, or memories. The general assumption of the conditioning approach was that anxiety was learned through association between neutral or accidental cues and traumatic events. McReynolds suggested the cognitive approach was evident among the writings of theorists such as Freud and Mowrer, while the conditioning approach was evident in the works of Watson, Locke, Hull, and Dollard and Miller.

After many years of research and writing, May (1977) provided a summary and synthesis of the theories of anxiety and suggested the following definition:

> Anxiety is the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality. The threat may be to physical life (the threat of death), or to psychological existence (the loss of freedom, meaninglessness). Or the threat may be to some other value which one identifies with one's existence: (patriotism, the love of another person, 'success', etc.). (pp. 205-206)

May viewed anxiety as purposeful, stimulating humans toward psychological growth. Without it there would not be a constructive struggle with life. He stated:

> Our very survival is the result of steps taken long ago to confront anxiety. . . . The form of anxiety has changed, but the experience remains relatively the same. . . . The presence of anxiety indicates vitality. Like fever, it testifies that a struggle is going on within a personality. So long as this

> struggle continues, a constructive solution is possible. (p. xiv)

Three groups of researchers who shed the most light on the anxiety construct as it relates to computer anxiety are Epstein (1972), Phillips, Martin, and Meyers (1972), and Spielberger (1972). In an attempt to synthesize the numerous definitions of anxiety, Epstein suggested that all the definitions allow a general description of anxiety as a "state of diffuse arousal following the perception of threat, or alternatively, as unresolved fear" (1972, p. 334).

Epstein concluded that anxiety is composed of three basic sources or conditions, each having a feeling association--*primary overstimulation*, *cognitive incongruity*, and *response unavailability*. Primary overstimulation involves frantic feelings of being overwhelmed to the limits of tolerance, sometimes associated with a feeling of pain. Cognitive incongruity occurs in situations where discrepancy exists between a cognitive plan or expectation and the individual's failure to cope. Feelings of confusion, disorganization, and disorientation are the associated feeling states. Response unavailability is a condition that occurs when the object producing the arousal is unknown, when there is conflict between opposing response feelings, or when a waiting period is required before any response can be made. The feeling state resulting from response unavailability is helplessness. The key issue, Epstein believed, is that the threat may only be

perceived, and not necessarily based in reality (Epstein, 1972, p. 303).

Phillips, Martin, and Meyers (1972, p. 412) further noted in their synthesis of the anxiety research that a trend exists to view anxiety as a two-part concept. "Trait" (anxiety) is a general proneness to be anxious and is dispositional or personality related. "State" (anxiety) is a direct function of a particular stressful condition and is located in a particular point in time. They also noted a trend to believe that anxiety can occur as a result of uncertainty associated with external factors as well as internal or cognitive factors.

Finally, Spielberger noted that it can be inferred from most research findings that it is meaningful to distinguish between anxiety as a transitory "state" and as a relatively stable personality "trait" (1966, p. 16). Spielberger refined and clarified these concepts throughout his research.

The concept of computer anxiety, as presented later in this chapter, appeared to be related to the issues of subjectively perceived threat (Epstein) and anxiety as it is reflected in personality trait (Phillips, Martin & Meyers; Spielberger).

State and Trait Anxiety

The state-trait concept of anxiety has been most prominent in the work of Cattell and Spielberger. Spielberger (1972, p. 484) added the concept of "anxiety-as-process," which refers

to the sequence of cognitive, affective, and behavioral responses that occur as a reaction to stress. The process, Spielberger believed, was as follows:

Stress (leads to) Perception of Danger (leads to) A-State Reaction.

The A-state, therefore, was at the core of the anxiety development process, leading the individual to the following sequence of reactions:

A-State (leads to) Cognitive Reappraisal (leads to) Coping, Avoidance, or Psychological Defenses.

Spielberger (1972) proposed that the term A-state be used to refer to the pattern of responses in an individual who perceives a particular situation as personally dangerous or threatening, irrespective of the (objective) presence or absence of danger. A-state reaction is experienced as an unpleasant emotional state consisting of feelings of tension, apprehension, worry, and heightened autonomic nervous system activity.

Most empirical work on anxiety has been concerned with defining characteristics of the anxiety state and identifying conditions that evoke it. Spielberger (1966) credited Krause, Lazarus, Schacter and Singer, and Martin with contributory research in this area. Beck, Epstein, and Mandler all emphasized the importance of cognitive factors in arousal of anxiety as an emotional state, leading Spielberger to conclude that anxiety states (i.e., A-states) "vary in intensity and

fluctuate over time as a function of the amount of stress that impinges upon an individual" (Spielberger, 1972, p. 482).

In contrast to A-state anxiety, experimental work related to the concept of trait anxiety (A-trait) has been concerned primarily with investigating differences between groups of subjects who differ in the anxiety levels that remain relatively stable over time. Spielberger (1972) suggested that A-trait measures such as the Taylor Manifest Anxiety Scale (1953), the IPAT Anxiety Scale by Cattell and Scheier (1963), and the A-Trait Scale by Spielberger (1970) reflected (generalized) anxiety-proneness in individuals. Spielberger also found that A-trait referred to differences among people in their response to (perceived) threatening situations with elevations in A-state intensity.

Further, Spielberger speculated that high A-trait persons had residues of past experience which influenced evaluation of anxiety, and that parent-child relationships centering around punishment were especially important in this regard. If Freud is considered as the pioneer figure in the theory of anxiety, and Spielberger as the foremost modern authority in the field, it is interesting to note that their conceptions of anxiety are comparable in many respects.

Anxiety Measurement

Both physiological and psychological characteristics of anxiety have received attention in the research literature.

2However, Sarason (1960) reported that the relationship between these two types of measures has not been found to be very strong. Responses such as blood pressure, pulse rate, respiration rate, galvanic skin response, and muscular action potential have received attention from researchers interested in physiological measures, and have tended to provide information related to A-state, or anxiety associated with activation of the autonomic nervous system.

Psychological measures have focused upon self-report instruments in the form of questionnaires, scales, and inventories. Four major psychological approaches to anxiety measurement have appeared in the literature. They are presented here briefly to provide perspective on the measurement of computer anxiety.

The Taylor Manifest Anxiety Scale (Taylor, 1953) is generally recognized as the basic or generic scale of anxiety measurement. It was originally developed to serve as a measure of drive in connection with Hullian learning theory and, as such, was not intended to be a direct measure of anxiety. However, it has served as a criterion against which many other measures have been validated. The scale was developed by selecting items from the Minnesota Multiphasic Personality Inventory judged to meet a clinical definition of chronic anxiety. The original scale has undergone several modifications.

A second scale of interest is the Multiple Affect Adjective Checklist, developed by Zuckerman (1960). In the use of this instrument, a subject checks a set of adjectives to describe how he or she feels. The adjectives themselves define the three affective dimensions of anxiety, hostility, and depression, and were originally validated by contrasting high and low groups on the three dimensions. One feature of the scale is its ability to measure both the state and trait nature of anxiety.

Following their earlier factor analytic studies identifying "trait" and "state" anxiety, Cattell and Scheier (1963) developed a 40-item IPAT Anxiety Scale. It is comprised of 20 items overtly measuring anxiety, and 20 items not obviously anxiety-bound. It was characteristic of Cattell's approach to regard factor analysis not as a data-reduction technique, but as a method for uncovering underlying, causal traits.

The fourth major approach to anxiety measurement was that proposed by Spielberger (1970). The State-Trait Anxiety Inventory, better known as the STAI, consisted of 20 items for each dimension of state and trait. The items for the trait dimension were selected based upon correlations with the Taylor Manifest Anxiety Scale, the IPAT Anxiety Scale, and Zuckerman's Affect Adjective Checklist. Items for the trait dimension were of the form, "I am content" or "I worry too much over something that really doesn't matter," requiring subjects to describe how they generally felt. These items were considered as being

stable over time. Items for the state dimension were of the form, "I feel calm" or "I am tense," requiring subjects to indicate how they felt at a particular moment in time.

Subsequent and continuing research on the STAI has become the basis for many scale development efforts, including those related to the concepts of test anxiety and math anxiety. Clearly, the STAI provided a logical and well-supported framework for validation of a computer anxiety scale.

Test Anxiety

Test anxiety, an aspect of general anxiety that is well known in the field of education, has been suggested by Cambre and Cook (1985) to be comparable to computer anxiety. Although test anxiety is commonly considered a recent phenomenon, the emotional reactions and physiological changes experienced by many students during examinations received attention as early as the turn of the century. Folin, Demis, and Smillie (1914; cited in Spielberger & Sarason, 1978) found that approximately 18% of medical students had sugar in their urine immediately after an examination, whereas the same students showed no trace of sugar before the examination. Later studies by Cannon (1929; cited in Spielberger & Sarason, 1978) also reported evidence of sugar in the urine of four out of nine students after a difficult examination.

The Russian physiologist Luria (1932; cited in Spielberger & Sarason, 1978) investigated the emotional reactions of

students in examination situations and concluded that testing environments roused intense emotional reactions in certain students, while other students appeared "stable." Neumann, a German investigator, published the first book on test anxiety in 1933. Other German researchers, such as Redl and Stenge, published papers on the etiology of test anxiety throughout the 1930s. Test anxiety was then explained in psychoanalytic terms, and its cause considered to be in traumatic childhood experiences. Between 1938 and 1949 a series of six articles based on studies of test anxiety were published by Brown at the University of Chicago. Brown (1938a, 1938b; cited in Spielberger & Sarason, 1978) also developed the first questionnaire to attempt to identify test-anxious students. On the basis of his research, Brown reasoned that students who became excited prior to their examinations tended to do less well than students who were calm before their examinations.

In the early studies on stress experienced during examinations, researchers such as Luria and others found an opportunity for assessing the physiological changes that take place in naturally occurring stress situations. The results of these studies were later to be supportive of Selye's research on stress, which began in the 1950s.

The theory of test anxiety presented by Mandler and Sarason (1952; cited in Spielberger, Anton, & Bedell, 1976) was an attempt to account for the varied effects of anxiety on performance in testing situations. In their research,

anxiety was inferred from responses to a questionnaire that contained items about past experiences in testing situations. The researchers found that high test anxious college students performed poorer on intelligence tests than did students who reported being low in test anxiety, and that the former did even more poorly when tested under stressful, ego-involving conditions.

Consequently, Mandler and Sarason proposed a theory encompassing two kinds of learned drives that were evoked in testing situations (Spielberger et al., 1976). One set of drives, labeled "learned task drives," is elicited by the demand characteristics of the task. Task-relevant responses are stimulated which then lead to reduction of the drive through completion of the task. A second set of drives, "learned anxiety drives," elicit two types of responses: task-relevant responses and task-irrelevant responses. Task-irrelevant responses are assumed to interfere dramatically with performance during testing situations. Mandler and Sarason (1952; cited in Spielberger et al., 1976) characterized these anxiety-evoked responses as "feelings of inadequacy, helplessness, heightened somatic reactions, anticipations of punishment or loss of status and esteem, and implicit attempts at leaving the test situation" (p. 166). These feelings are considered self-centered rather than task-centered.

Alpert and Haber (1960; cited in Spielberger et al., 1976) re-labeled the two sets of drives as facilitating and

debilitating anxiety. Facilitating anxiety serves to evoke responses that increase the probability of successful task completion, while debilitating anxiety creates nontask-related coping mechanisms that distract from the task and thus interfere with successful performance.

On the basis of factor analytic studies, Morris and Liebert (1970) suggested that test anxiety consists of two major components: worry and emotionality. The worry component refers to (primarily) cognitive concern about the consequences of failure while the emotionality component refers to autonomic reactions in response to testing situations. Worry interferes with performance on cognitive and intellectual tasks, while the emotionality factor typically is not related to task performance except for subjects who are low on the worry factor.

In a comprehensive review of the test-anxiety literature, Wine (1971) used Morris and Liebert's concepts of worry and emotionality to suggest an "attentional" component. She believed that "high test-anxious" persons have attention divided between the demands of a task and the self-criticizing cognitive activities that are task-irrelevant. Wine proposed that under stress, high test-anxious persons divide attention between "self-relevant" and "task-relevant" responses while "low test-anxious" persons focus their attention more fully on the task itself.

Sarason was a major contributor to development of a theory of test anxiety during the late 1950s and 1960s (Spielberger et al., 1976). His (later) research was concerned with investigating personality characteristics and situational factors that contributed to low performance in high test-anxious persons. Sarason believed that high test-anxious persons were more self-centered and self-critical, and more likely to display personalized, self-centered, and derogatory responses. Sarason (1972; cited in Spielberger et al., 1976, p. 321) described the behavior of test-anxious persons as follows:

> Whereas the less test-anxious person plunges into a task when he thinks he is being evaluated, the highly test-anxious person plunges inward. He either (1) neglects or misinterprets informational cues that may be readily available to him or (2) experiences attentional blocks.

There appears to be a parallel between Sarason's description of the high test-anxious person and Wine's belief that distractibility is caused by self-centered worry. In 1975, Sarason attempted to integrate and extend the earlier views. He stated, "In my view, a person's level of test anxiety is, to a significant degree, a product of experiences that influence what he attends to in himself and in the world" (p. 175). The high test-anxious person, Sarason believed, either neglects or misinterprets informational cues that may be readily available to him, or experiences attentional blocks.

Test anxiety theorists seem to agree that test-anxious persons perceive testing situations as more dangerous or threatening than do persons who are low in test anxiety, and that they experience thoughts of worry and intense state anxiety reactions to these situations. While in test anxiety theories there has been a tendency to recognize state anxiety reactions, the theories have more often focused on the importance of the worry component in contributing most to performance decrements on tests. Morris and Liebert (1970; cited in Spielberger et al., 1976) contended, "It is worry, not 'anxiety' which affects performance on intellectual-cognitive tasks and which interacts with the relevant variables of the test situation" (p. 323).

In the context of his State-Trait Anxiety Theory, Spielberger (1972) contended that test anxiety is a situation-specific form of trait anxiety, or reflects a situation-specific personality trait. In test situations, the high levels of A-state roused in trait test anxious persons bring about error tendencies, and distracting worry responses. It was feasible to explore the likelihood that computer anxiety also is a situation-specific form of trait anxiety.

This study examined the relationship between test anxiety and computer anxiety and the related possibility of computer anxiety as a situation-specific form of trait anxiety.

Measurement of Test Anxiety

A review of the literature on test anxiety measurement was conducted to identify the most appropriate instrument for use in validation of a computer anxiety measure. Beginning in the 1950's, several instruments designed to measure test anxiety appeared in the professional literature.

The first instrument to be used widely was developed by Mandler and Sarason (1952). An initial 42-item questionnaire was designed to assess individual differences in tendency to emit self-oriented, interfering responses (both cognitive and physiological) before, during, and after testing situations. After item analyses, 37 questions were retained that discriminated reliably between extreme groups. These questions were clustered to form the Test Anxiety Questionnaire (TAQ). Subjects were asked to report the extent to which they experienced symptoms of anxiety on a graphic rating scale with specified anchor points. The TAQ split-half reliability for a sample of 100 was .99 and the test-retest reliability over a 6-week interval was .82. In later studies, positive correlations were found between the TAQ and behavioral ratings of manifestations of anxiety, and negative correlations were reported between the TAQ and various measures of intellectual aptitude (Sarason, 1960).

Subsequent to the TAQ, Sarason (1958) developed a 21-item Test Anxiety Scale (TAS) using questions taken from the TAQ but rewritten in true-false format. The TAQ questions were

later decreased to 16 items in 1962, and published by Sarason and Ganzer (1962). Presumably the best items were extracted from the longer scale, although this is unclear. Finding a need for increased sensitivity and reliability, Sarason (1972) later added items, and correlation of the final 37-item version with the 16-item earlier version was .93. Although the TAQ and the TAS have been widely used in research on test anxiety, normative data and a systematic presentation of correlates are still unavailable.

Alpert and Haber (1960) developed the Anxiety Achievement Test (AAT) to measure facilitating and debilitating anxiety in evaluative situations. The Facilitating Anxiety sub-scale (AAT+) is comprised of 9 items while the Debilitating Anxiety sub-scale (AAT-) consists of 10 items. Available psychometric information about the AAT is more detailed, but it has been used less extensively than either the TAQ or the TAS.

Relying on their belief that test anxiety consisted of two components (i.e., worry and emotionality), Liebert and Morris (1976) developed short, 5-item scales to measure each component. They selected items for Worry (W) and Emotionality (E) from items on the TAQ on the basis of presumed content validity. They found scores on the W scale to be negatively related to performance on a variety of tasks. Contrastingly, they found scores on the E scale were unrelated to task performance in two studies, and negatively correlated with

performance in a third study, but only among subjects scoring low on W.

The Suinn (1969) Test Anxiety Behavior Scale (STABS) was designed specifically to measure test anxiety in relation to behavior therapy research (Spielberger et al., 1976). This scale consists of 50 items which describe test-related behavioral situations. At the time of its introduction, this scale held promise as a measure of the effectiveness of treatment of test anxiety. However, by 1974, Spielberger and others had begun development of a new instrument with two goals in mind: to construct a relatively brief scale that correlated with other test anxiety measures, and to employ factor analytic procedures for identifying subscales to measure worry and emotionality.

The new instrument was called the Test Anxiety Inventory (TAI) (Spielberger, Gonzalez, Taylor, Algaze, & Anton, 1978). The first step in its construction was administration of Sarason's TAS to 426 students in psychology and reading improvement classes. After computation of point-biserial correlations between individual items and total scores, 22 of 37 items were retained, revised, and simplified. Further, the retained items were modified from a true-false format to the rating scale format of the STAI A-Trait scale (which asked subjects to respond according to how they generally felt on a 4-point scale of almost never, sometimes, often, and almost always). After adding 6 items with worry and emotionality

content, the instrument was administered to a new sample of 300 students. After computation of item-remainder correlations, 22 items remained and were factored using the principal factors method with varimax rotation. Clearcut emotionality (E) and worry (W) factors led to construction of subscales, and a final 20-item instrument.

Spielberger concluded the TAI had excellent potential for use in the assessment of test anxiety as a situation-specific personality trait. Consequently, this instrument appeared to have clearcut potential for concurrent validation of a scale to measure computer anxiety.

Math Anxiety

A second specific manifestation of anxiety that has captured the attention of researchers over the years, and has been compared to computer anxiety (Cambre & Cook, 1985), is that of math anxiety. Considered a state-type anxiety, it has been defined as ". . . feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematics problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p. 551). Math anxiety has been of particular interest to educational researchers and to counselors who frequently confront its devastating symptoms in their clients.

Math anxiety has become so prevalent that it has often prevented students from passing essential mathematics courses

and from pursuing careers in the sciences. Further, in a technological society, the need for mathematics skills has become increasingly vital. Approximately ten years ago Sells (1978) referred to math ability as "the critical filter in the job market" (p. 28). Tobias (1978) wrote that "whether one approves or disapproves. . . literacy has a new dimension: mathematical competence" (p. 43). Thus mathematics anxiety, as an inhibitor of mathematics performance, is significant in the helping professions.

A number of studies in the 1970s (e.g., Aiken, 1976; Betz, 1977, 1978; Luchins & Luchins, 1979; Pascarella, 1978) focused on causes and prevalence of math anxiety. It was found that variables including age, sex, experience with mathematics teachers, prior mathematics training, and general anxiety levels may interact with math anxiety. However, although no precise causes were identified, authors such as Fox, Fennema, and Sherman (1977) and Tobias (1978) strongly suggested that sexual stereotyping and social conditioning exerted a strong influence for females who were math anxious.

Math anxiety has been used as an independent variable in at least one study by Raub (1981), who attempted to define and measure computer anxiety. Math anxiety was found to be a significant contributor to computer anxiety for females. Therefore, this study justifiably included math anxiety as a factor in concurrent validation of an instrument measuring computer anxiety.

Measurement of Math Anxiety

A review of the literature on measurement of math anxiety revealed that only a few instruments have been developed to date. As with the measurement of the general anxiety construct, many of the difficulties in measuring math anxiety have been traced to a lack of agreement among researchers regarding the concept of mathematics anxiety. Aiken and Dreger (1961), relying on an earlier definition of "mathemaphobia" used by Gough (1954), constructed a scale of 20 items which they believed defined the "presence of a syndrome of emotional reactions to arithmetic and mathematics" (p. 20). Some years later, Fennema and Sherman (1976) produced the Fennema-Sherman Mathematics Anxiety Scale, comprised of 12-items, to assess feelings of anxiety associated with math classes, problems, and tests. Unfortunately, little research has been reported that examines the validity and reliability of either of these scales.

A semantic differential instrument was developed by McCallon and Brown (1971) in an effort to measure attitudes toward math using a non Likert-type response format. They claimed construct validity for their instrument, after having correlated it with the survey of Aiken and Dreger.

The most widely used instrument for measuring math anxiety, and the one that appears most appropriate for concurrent validation of a computer anxiety instrument, is the Mathematics Anxiety Rating Scale (MARS), developed by

Richardson and Suinn (1972). The MARS consists of 98 items with a Likert-type response format ranging from 1 = not at all to 5 = very much. One hundred nineteen students from a large state university were sampled for normative data. After two weeks the test-retest reliability coefficient was .78, significant at .001 level. Validity data were obtained by administering concurrently the mathematics section of the Differential Aptitude Test (DAT) and the MARS. Correlations between the MARS and the DAT were -.35 ($p < .05$) for the original testing and -.32 ($p < .05$) for the retesting, indicating high anxiety was associated with low performance on the DAT, and vice versa.

Underlying several additional validity studies by the researchers was the assumption that mathematics anxiety, as measured by the MARS, is a unidimensional construct. Rounds and Hendel (1980) questioned that assumption as did Resnic, Viehe, and Segal (1982) who later identified three factors in math anxiety: evaluation anxiety, arithmetic computation anxiety, and social responsibility anxiety. The MARS, however long and time-consuming to administer, is to date the instrument most widely used to measure math anxiety, and was used in this study for concurrent validation purposes.

Internal-External Locus of Control

Along with measures of trait anxiety, test anxiety, and math anxiety, this study included a measure of locus of control

as an indicator of concurrent validity. Internal versus external control of reinforcement (I-E) was first outlined by Rotter (1966). I-E is regarded as a generalized expectancy to categorize situations that present the individual with a problem to be solved. Rotter not only defined the concept, but also described a social learning theory framework in which it could be incorporated.

Social learning theory illustrates how choices are made by individuals from the variety of potential behaviors available. Phares (1976) noted that to determine which behavior has the strongest potential for occurrence, one must consider <u>expectancy</u>, <u>reinforcement value</u>, and the <u>psychological situation</u>. Expectancy is "the probability held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation or situations" (Rotter, 1954, p. 107). Thus, expectancy is a subjective probability for each individual. According to the theory, a person's subjective feelings about the probability of being reinforced for some behavior may or may not coincide with the realistic probability. Rotter stressed that it is not the situation per se which is important in predicting behavior, but rather the way in which a person perceives the situation (Rotter & Hochreich, 1975). Reinforcement value in social learning theory refers to the "degree of preference for any reinforcement to occur if the possibilities of their occurring were all equal" Rotter,

1954, p. 107). Reinforcement value is a relative term. For example, money acquires reinforcing aspects because it allows individuals to buy products and services that are important to them. However, criticism from loved ones regarding desire for money may reduce its reinforcement value.

Phares (1976) stated that careful analysis of situations is necessary to identify cues that may directly affect the expectancies and reinforcement values for any given person. Thus, the psychological situation in social learning theory is an important determinant of behavior.

The I-E scale developed by Rotter (1966) was constructed within the context of social learning theory. Earlier attempts by Phares (1957) and James (1957) to measure individual differences in a generalized expectancy (or belief in external control) as a personality variable were broadened by Rotter. Internal control refers to an individual's perception that events (reinforcements) are the result of his or her own behavior, efforts, or relatively permanent characteristics. External control, on the other hand, involves perceptions that events occur as a result of luck, chance, fate, interventions of powerful others, or are unpredictable because of the complexity of events. Beliefs about locus of control can fall anywhere along a dimension marked by internal beliefs at the one extreme and internal ones at the other.

The 29-item scale that emerged from Rotter's research is a forced-choice, self-report inventory containing items similar to the following format (Rotter, 1966, p. 11):

(a) In the long run, people get the respect they deserve in this world.

(b) Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

A substantial body of data on construct validity has been accumulated for the I-E scale. Results of factorial analyses allow the conclusion that a single general factor accounts for most of the I-E's variance. Split-half and Kuder-Richardson reliabilities cluster around .70, and retest reliabilities are at the same level but vary with the length of the interval (Phares, 1976).

As discussed later in this chapter, locus of control as a situation-specific expectancy has been found to be a reliable predictor of attitudes toward computers.

Computer Anxiety

In recent years, interest has been focused on a suggested addition to the specific anxiety manifestations previously discussed in this chapter. Some researchers (e.g., Cambre & Cook, 1985) have purported that "computer anxiety" is comparable to "test anxiety" and "math anxiety," and as such, should be identified, measured, and prevented and/or remediated. In order to explore the literature on the nature and

measurement of computer anxiety, a search was made through sources such as ERIC and PSYCINFO. A limited number of studies focusing on the development of measures of computer anxiety was found. Articles exploring attitudes towards computers, as well as potential correlates of computer anxiety, also were reviewed.

Measurement of Computer Anxiety

Three studies have been concerned with indirect measurement and operational definition of computer anxiety. The first was conducted by Powers et al., (1973), who defined computer anxiety as changes on four established physiological measures: systolic blood pressure, diastolic blood pressure, heart rate, and electrodermal response. The authors studied the relationships between user anxiety level and use of mainframe computer facilities, "hands-on" computer experience, and prior computer exposure. The study was initiated from a perspective that presence of anxiety would interfere with learning about computer use.

Base line data were established on the four physiological measures for 18 male college volunteers divided into 3 groups based upon prior experience with computers. These measures were recorded at 13 time intervals over a two-hour period. Using *t*-tests for correlated measures for each group and for combined groups on the four physiological measures, the authors concluded that continued exposure to computer usage reduced

anxiety below pre-exposure levels. However, no single physiological measure was considered adequate to assess fully the changes related to anxiety. Although the present study does not include physiological measures, it does include level of computer experience as a variable.

Stevens (1980) surveyed a random sample of 1,206 teachers to assess knowledge of and attitude toward computers. Computer anxiety was not specifically defined in the study, although the concept was acknowledged. It was found that teachers expressed higher levels of anxiety regarding use of computers than did student teachers or teacher educators. Further, all three groups expressed less anxiety being around computers than talking about them. It may be that teachers find and/or seek less opportunities for interaction with computers than do teacher educators and student teachers.

Also studying attitudes, Jordan and Stroup (1982) assessed students before and after using a computer in an introductory data analysis course. They defined computer anxiety operationally by using a 5-point, Likert-type scale for the statement "I am afraid to use computers," and conducted a discriminate analysis to distinguish among characteristics of those who indicated fear of using computers, those who indicated not being fearful, and those who indicated a middle position. Of five independent variables entered into the analysis, gender was found to be the strongest discriminator of computer anxiety, with females more fearful than males (.08 level).

Consequently, gender was used as a variable of interest in the present study.

Researchers who have provided conceptual definitions of computer anxiety by attempting to develop direct indices of it have generally hypothesized that it corresponds to the idea of anxiety state rather than anxiety trait. However, as has been shown, math anxiety and test anxiety have both been found to be related to A-Trait anxiety. In an attempt to examine this relationship, Raub (1981) developed an "Attitudes Toward Computers" scale designed to assess the cognitive component of the anxiety response. He examined three related features of computer anxiety in college students: (a) What attitudes and beliefs do students have about computers that cause them to feel anxious, (b) What are the correlates of computer anxiety, and (c) To what extent does hands-on computer experience reduce computer fear?

Raub addressed the first question through use of a 42-item questionnaire. The responses from it were subjected to a principal components factor analysis after it had been administered to 220 undergraduates from four colleges. Forty items were selected for a final form. Orthogonal factors derived from the analysis were labeled "Appreciation of Computer Technology," "Computer Usage Anxiety," and the "Computer's Negative Impact on Society."

To assess the emotional component, Raub developed a "Computer Usage Checklist," which consisted of adjectives

selected from the Zuckerman Affect Adjective Check List. An initial 65 words were reduced through tryout to 37, with 14 being considered anxiety plus, 12 as anxiety minus, 7 as describing helplessness, and 4 as representing hostility toward computers. The final instrument was administered to subjects as they sat at a computer terminal prior to instruction. Scores were used to select high anxious students for clinical interviews about their feelings of anxiety.

Reduction of computer anxiety was examined by comparing changes in computer attitudes over a semester among two introductory computer programming classes and one introductory psychology class. In addition to using his own instruments, Raub utilized Spielberger's Trait-Anxiety Scale and the Mathematics Anxiety Scale. From a regression analysis, five independent variables were found to be significant contributors to computer anxiety: gender, level of computer experience, college major, math anxiety, and trait anxiety. Using Spielberger's theory, Raub hypothesized that a greater portion of A-trait persons would exhibit A-state reactions when confronted with computers.

The second study of note reported in the literature, and the first to attempt development of an instrument to measure computer anxiety directly, was that of Rohner and Simonson (1981). Computer anxiety was defined as "the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (p.

551). The authors developed 63 statements having a Likert-type response format, of which 21 were cognitive in nature, 22 were affective, and 20 were behavioral. Thirty-two subjects from educational media classes at Iowa State University took part in a pilot study. After item analyses, 10 statements were selected to compose the Computer Anxiety Index (CAIN), while another 20 statements from the initial set were randomly included as distractors.

The instrument was administered to 178 subjects in educational media classes, along with the Group Embedded Figures Test as a measure of field dependence, and Your Style of Learning and Thinking Test (SOLAT), measuring brain hemisphericity. Results of the CAIN were correlated with the other tests, as well as with gender and subject area in which the respondent was planning to teach. Reliability of the CAIN was determined by interitem consistency (i.e., Cronbach's Alpha) to be .88 in the pilot study and .86 in the main study. No significant relationship to any of the other variables was found, although a slight tendency was found for left hemispheric dominant subjects to have more computer anxiety.

Building on the work of Rohner and Simonson, and attempting to revise the CAIN, Maurer and Simonson (1984) presented a paper outlining their study, also conducted at Iowa State University. Computer anxiety was defined "as the irrational fear or apprehension felt by an individual when using computers

or when considering the possibility of computer utilization" (p.321).

The CAIN was revised to measure the trait of computer anxiety and to be predictive of the development of the state of computer anxiety. It used a 6-point, Likert-type scale; the number of items was not indicated in the paper. Two pilot studies were conducted and reliability was measured in regard to internal consistency and stability. A reliability of .94 was determined by Cronbach's Alpha and test-retest reliability was .90. Spielberger's STAI (A-state) was administered as a concurrent measure of computer anxiety, and was given to subjects as they were seated in front of their computers. The CAIN and the STAI were found to correlate significantly at .32 (p <.01) among a sample of 111 subjects. Again, students enrolled in undergraduate instructional media classes were used as subjects. Clearly, these two studies lacked sampling procedures able to support widespread generalizability of the results.

Jones and Wall (1985) presented the results of two pilot studies using the CAIN to assess the effect of computer experience on those persons affected by computer anxiety. The CAIN was administered to 21 graduate students in instructional technology and 22 graduate students in education at the University of Maryland. The authors concluded that a significant relationship existed between computer anxiety and

computer experience or exposure, supporting Raub's findings from a few years earlier.

Attitudes Toward Computers

Although not pertaining to direct measurement of computer anxiety, several studies were reviewed which presented the results of attitude measurement regarding computers, as well as computer knowledge. The first of these was by Loyd and Gressard (1984), who developed the Computer Attitude Scale (CAS). It consisted of 30 items which were statements of attitudes toward computers and the use of computers. Three types of attitudes were represented: lack of anxiety or fear of computers; liking of or enjoying working with computers; and confidence in ability to use or learn about computers. Although the instrument was developed from responses of 155 students in grades 8 through 12 who were involved in a computer-based education program in a large school district, it was used a year later with teachers to provide validation data for use with adults.

The originators of the CAS, Gressard and Loyd (1985), conducted three validation studies, administering their instrument to elementary, middle, and secondary school teachers enrolled in staff development programs. They concluded that the total score on the CAS represented a general attitude toward computers that reflected liking, confidence, and freedom from anxiety.

Further refinement of the instrument was attempted by Loyd and Loyd (1985) who added a fourth subscale related to computer usefulness in order to assess attitudes among high school teachers. The subjects were 114 teachers of grades K through 12 enrolled in six classes involving use of microcomputers in education. From the results of factor analysis it was suggested that the subscales for lack of anxiety and confidence measured the same trait, and that the remaining two subscales lacked unique variance to support interpretation of a separate score. It would appear, therefore, that the validity of the CAS is questionable.

During the same year, Torardi (1985) developed an instrument to assess computer literacy, called the Standardized Test of Computer Literacy (STCL). Consisting of 80 items, the instrument was considered a valid and reliable measure of computer literacy, or computer knowledge. In an attempt to relate knowledge, attitudes, and anxiety regarding computers, Toris (1984) presented a paper outlining a four-part questionnaire which was developed at the College of Charleston. The first part was a projective technique which required the examinee to draw a scene with a computer in it and write a description. The second part was a questionnaire of computer knowledge, and the final two sections were self-report descriptions of the examinees' behaviors involving computer use and attitudes. Unfortunately, no information regarding validity or reliability was presented for this instrument.

According to Coovert and Goldstein (1980), one of the best predictors of attitudes toward computers is Rotter's (1966) measure of locus of control. The authors found externalizers, i.e., persons who perceive events in their lives as being beyond personal control, as the most likely candidates to experience computer anxiety. Their findings were compatible with the general locus of control literature which suggests that persons with an external locus are more likely to have elevated levels of anxiety, especially when their personal adequacy is being challenged (Spielberger, O'Neil & Duncan, 1972).

In Coovert and Goldstein's research, externalizers were more likely to make statements implying that the computer controlled them rather than the reverse. Also, internal scorers had a more positive (i.e.,favorable) attitude toward computers than did external persons.

Based on the conclusion from the literature that locus of control is a stable personality trait that can be related to level of anxiety, and the assumption that it is a predictor of a human-computer relationship, it warranted inclusion in a concurrent validation of a computer anxiety measure.

Anxiety and Potential Health Effects of Computer Terminals

A newspaper article by Boffey (1988) referred to the sporadic fears that arise regarding any new technology and the introduction of unexpected health problems after prolonged use.

Fueled by the results of a study conducted on Long Island, the state legislature of New York passed a law in 1988 requiring companies to subsidize annual eye exams for video display terminal workers. Although the American Academy of Opthamology found no convincing evidence that computer terminals are hazardous to the eyes from levels of radiation emitted, there was evidence of eye irritation, fatigue, headaches, and difficulties in focusing.

According to Boffey, every expert group has largely discounted risks of any major or permanent health damage, although each new study has produced a fresh wave of public concern. For example, a study by Goldhaber previous to 1984 (cited in Boffey) examined 1,600 women two and a half years after pregnancy, and reported that workers who recalled spending more than 20 hours each week at a video terminal were almost twice as likely to have experienced miscarriages as working women who did not use computers. This study claimed the first significant evidence that working at computer terminals could effect adversely the outcome of pregnancy. Critics of the study suggested that radiation was less likely an explanation than stress produced by the monotony of the work, and in 1984 the American College of Obstetricians and Gynocologists concluded that radiation emitted by computer terminals was insufficient to cause spontaneous abortion or birth defects.

Review of the recent literature did not reveal adequate evidence of fear of physical harm from computers as widespread. Moreover, since this study approached computer anxiety as a potential situation-specific form of trait anxiety, a decision was made not to include fear of physical harm as a (item) variable.

Summary of Computer Anxiety Literature

Since each of the studies reviewed approached the concept of computer anxiety from a slightly different framework, generalization was difficult, and trends were not clear. However, need for further research was evident from the following:

Two studies (Raub, 1981; Maurer & Simonson, 1984) explored the relationship between computer anxiety and state-trait anxiety. Both researchers wrote that computer anxiety seemed to be a state anxiety brought about by anticipation of computer use or computer use itself; however, Raub found a relationship between trait anxiety and computer anxiety only among male subjects. Further study of the relationship between computer anxiety and state-trait anxiety was indicated.

Cambre and Cook (1985) suggested that math anxiety and test anxiety have potential similarities to computer anxiety. Two studies (Raub, 1981; Gressard & Loyd, 1984) provided evidence of a positive relationship between math anxiety and computer anxiety. The relationship of test anxiety to computer

anxiety has not yet been explored. However, it has been identified by Spielberger (1972) as a situation-specific form of trait anxiety, and as such, warranted further attention in its relation to computer anxiety.

Locus of control as a predictor of attitudes toward computers has been supported by the study of Coovert and Goldstein (1980), and warranted further attention as a potential correlate of computer anxiety. Considered a stable personality trait, and supported by the literature (Spielberger et al., 1972) as being related to trait anxiety, it held promise as a measure useful for concurrent validation purposes.

Four studies used gender as an independent variable. Two of these (Raub, 1981; Jordan & Stroup, 1982) presented relationships between their measures of computer anxiety and gender. Vrendenberg (1984) reported that in response to a self-report questionnaire, females reported greater fear of computers than males.

College major was used in two studies (Raub, 1981; Rohner & Simonson, 1981) as an independent variable. Although not found significant in either of these studies, it needed further exploration with broader sampling techniques.

Level of computer experience was included as a variable in Raub's (1981) study only. It correlated significantly with computer anxiety, and therefore warranted further consideration.

With few exceptions, the studies reviewed tended not to build upon one another, although most were related to the general anxiety theory. What appeared most obvious was the lack of generalizability in the instruments constructed, and the need for a valid and reliable instrument to assess computer anxiety.

Definition of Computer Anxiety

Several points related to the definition of computer anxiety emerged from the literature and were considered significant for this study. The first is that computer anxiety involves a complex array of emotions including apprehension, fear, feelings of personal threat, and hope. Second, these emotional reactions may be triggered when considering the personal implications of using a computer, and when planning or actually interacting with a computer. The final point is that personal threat regarding computers is perceived, rather than reality-based.

These elements provided a framework for the definition of computer anxiety used in this study. The work of Epstein (1972) further contributed to the definition. He suggested a description of anxiety as including "diffuse arousal following the perception of threat" and "unresolved fear," and in addition denoted the confusion and disorientation that follow failure to cope with a threatening situation. Spielberger (1966) studied the disposition of some individuals to

perceive objectively non-dangerous circumstances as threatening, and his concept of trait anxiety as a "tendency" was used in the present definition. A final aspect of computer anxiety as defined by this study was derived from the literature regarding locus of control as a predictor variable. This literature strengthened the assumption that externalizers (i.e., who tend to have less favorable attitudes toward computers) also will tend to personify the computer, or "empower" it.

For the purposes of this study the initial definition of computer anxiety incorporated previous definitions found in the literature, as well as aspects of anxiety supported by related research. Consequently, computer anxiety was first defined as <u>the tendency to experience unresolved apprehension or fear when anticipating interaction with a computer, as well as the tendency to experience exaggerated feelings of disorientation and uncertainty when interacting with a computer. It was also characterized by feelings of personal threat when considering the implications of interaction with a computer, contributing toward a tendency to personify the computer.</u>

Summary of Literature Review

A selected review of the general anxiety construct and its measurement has been presented as a framework for considering computer anxiety. Test anxiety, math anxiety, and locus

of control have been discussed as specific anxiety manifestations with potential similarities, particularly as they relate to the construct of computer anxiety. A number of studies have been identified and discussed for their contributions to the definition, measurement, and determination of correlates of computer anxiety.

The implication drawn from the literature is that previous studies had not led to development of an instrument suitable to the measurement of computer anxiety in a general population of college students. This study was a response to that absence.

CHAPTER III

METHODOLOGY

The rise of micro-computer technology has brought with it a new problem for a portion of the general population. One of the psychological reactions to personal computers is computer anxiety, which is related to avoidance of computers in the educational world, the job market, and in personal life. In order to guide persons to more helpful responses to personal computers, an instrument to assess the extent of computer anxiety was needed within the counseling profession. This need in turn necessitated the development and validation of a suitable measuring device.

The first portion of this chapter describes the methodology involved in the initial development, field testing and refinement of a preliminary form of the Computer Anxiety Rating Scale (P-CARS). The remainder of the chapter describes the procedures by which the refined instrument (CARS) was examined for reliability, validity, and factor structure, as well as its relationships to demographic variables of the subjects. A discussion of the inherent methodological limitations of the study concludes the chapter.

Initial Item Generation

An analysis of the literature reviewed in Chapter II led to recognition of the need for a systematic approach to assessment of computer anxiety based upon varied aspects of the general anxiety construct. Anxiety and its measurement have been discussed, among others, by Taylor (1953), Zuckerman (1960), Cattell and Scheier (1963), Epstein (1972), Philips, Martin, and Meyers (1972), and Spielberger (1972).

Raub (1981), Rohner and Simonson (1981), and Maurer and Simonson (1984) contributed definitions and measures of computer anxiety. A subsequent definition of computer anxiety for use in this study was developed based upon definitions found in the literature, as well as aspects of anxiety supported by related research. From this definition, four general components emerged which represent basic assumptions regarding the nature of computer anxiety. These components are identified as follows: (a) Feelings of Unresolved Anxiety, (b) Feelings of Disorientation, (c) Perceived Threat Responses, and (d) Personification Responses. They are not mutually exclusive nor exhaustive, and are not considered equal in terms of scope or subject matter. They were chosen to represent the major components of computer anxiety as defined by this study.

The four elements of computer anxiety and their subcomponents were incorporated into a conceptual outline (see Table 1) from which the items were generated. The outline was reviewed separately by a university faculty member who teaches

Table 1

Preliminary Outline of Components of Computer Anxiety

Items		
	I.	Feelings of Unresolved Anxiety
1 ,5, 9	A.	Anticipation of negative feelings
13,17,21	B.	Cognitive thoughts accompanied by negative feelings
25,29,33	C.	Acceptance of negative feelings
37,40,43	D.	Avoidance behavior
46,47,48	E.	Avoidance of new learning
	II.	Feelings of Disorientation/Uncertainty
2, 6,10	A.	Feelings of confusion
14,18,22	B.	Feelings of being overwhelmed
26,30,34	C.	Immobilization
	III.	Perceived Threat Responses
3, 7,11	A.	Lack of confidence
15,19,23	B.	Feelings of inadequacy
27,31,35	C.	Fear of appearing foolish
38,41,44	D.	Negative attitude
	IV.	Personification Responses
4, 8,12	A.	Fear of replacement
16,20,24	B.	Perception of unlimited power
28,32,36	C.	Perception of ability to reason
39,42,45	D.	Lack of trust

research, a retired university faculty member knowledgeable in test construction, a Florida State University System researcher, a computer science student working as a tutor in a university computer laboratory, and a consultant in computer systems. These persons were asked to evaluate the components in regard to their logical and/or rational relationship to the definition of computer anxiety as defined by the test constructor, the comprehensiveness of the outline, the validity of the categories, and the content within each category. The components were refined on the basis of these consultations, and are discussed below. Subsequent agreement was reached by the reviewers regarding the components and the concepts included in each.

Components of Computer Anxiety

The first component of computer anxiety consists of feelings of unresolved anxiety. Sub-components include anticipation of negative feelings, (e.g., being uncomfortable, nervous, or panicky), as well as the experience of negative feelings when contemplating future interaction with computers. A somewhat passive acceptance of these negative feelings accompanies the anxiety. Furthermore, when the apprehension or anxiety is unresolved, it leads to avoidance behavior, i.e., evading opportunities for "hands-on" experience with computers and/or the classroom knowledge related to computer use.

One of the associated feeling states of anxiety is that of the disorientation and uncertainty which occurs when the individual fails to cope within his/her own expectations. This second component of computer anxiety leads to an experience best described as confusion. A further result of anxiety is the lack of an adequate response, which in turn leads to feelings of being overwhelmed and conditions of high anxiety, helplessness, and the feeling of being immobilized.

The third component of computer anxiety is the perception of personal threat associated with potential or actual use of a computer. Lack of confidence appears related to unfamiliarity with computer technology, and feelings of inadequacy appear related to a tendency to downplay one's own ability to deal with this technology. Also relevant is the fear of appearing foolish or "dumb" when using a computer in front of others. The result of perceived personal threat is a general negative attitude toward personal use of computers.

A final component of anxiety related to computers involves the personification, or "empowering" of the computer with human characteristics. One threat to the ego is that of fear of being replaced in the job market or of having one's skills superceded by computer technology. An associated fear is that computers have unlimited capabilities, and are therefore perceived as being powerful. Computer language has become quite sophisticated and the resulting software packages so

impressive that an illusion is created that computers are able to think and reason in a human-like fashion. A lack of trust, or feeling that the computer is not "emotionally" dependable, often results. This concept was discussed in Chapter II as it relates to those persons with an external locus of control (e.g., externalizers) as being more likely to have negative attitudes toward computers.

Item Pool

An initial pool of 48 items was constructed based upon careful examination of the definition of computer anxiety and its components. An attempt was made to write or adapt items from previously available materials on computer anxiety that logically and rationally reflected the characteristics of anxiety indicated by the sub-components. If an item pool is being used for the first time, Nunally (1978; cited in Hulin, Drasgow, & Parsons, 1983) suggested that the initial item pool should contain twice as many items as desired in the final instrument. In order to create a large enough pool of items to allow for elimination, three items were constructed for each of 16 sub-components of the definition.

A five-point, Likert-type response scale was selected because of its familiarity to subjects and ease of resultant data manipulation. The five responses on the preliminary form were Strongly Disagree (SD), Disagree (D), Uncertain (U), Agree (A), and Strongly Disagree (SD), with corresponding

weights ranging from 1 through 5. Items were phrased both positively and negatively in order to avoid formation of a response set by the subjects, and the scoring was adjusted accordingly (i.e., reversed). A high positive response was considered to represent high computer anxiety, and a low positive response to represent low computer anxiety. The scale and instructions were designed for either individual or group administration. The questionnaire was constructed to be self-administered and scored either with the use of optically-scanned answer sheets or by hand.

The initial pool of 48 items was reviewed by a faculty member who teaches research and is familiar with test development procedures. This review resulted in several suggestions for refinements in the wording of the items and for relating items to the sub-components. The items were then reviewed by a faculty member who teaches curriculum development, a Florida State University System researcher, and a faculty member who teaches research design. The reviewers were asked to evaluate the items on the basis of clarity of wording, logical relationship to the sub-components of the definition of computer anxiety, format, comprehensiveness of the content, and ambiguity of items and instructions. Several suggestions resulted in refinements in the wording of the items. Final refinement resulted in re-ordering the items to avoid a response set due to sequential placement of related items.

Shown in Table 1 are the items by sub-category of computer anxiety. The 48 items in the preliminary form of the instrument are provided in Appendix A. This appendix includes an introductory statement, demographic items, the questionnaire, and a feedback form. Collectively, they comprised the initial form of the instrument used in the developmental study.

Refinements

The second stage of test construction consisted of two procedures. The first procedure was administration of the developmental form to a sample of subjects for the purpose of obtaining feedback related to the clarity or ambiguity of the instrument, its items, and its administration. The second procedure involved evaluation of the items by two experts in psychometric construction. Together, these procedures comprised the developmental (i.e., pilot) study. A description of the developmental study is contained in Appendix B. As a result of this study, 34 items comprised the P-CARS.

The third stage of preliminary test construction involved evaluating the reading level of the P-CARS items. Reading level is evaluated on the basis of length of sentences, number of syllables, and number of unfamiliar words (Fry, 1968). An initial analysis was made by submitting the 34 items to an evaluation by RightWriter, a computer software program designed to assess reading level as well as grammatical constructions.

RightWriter is based upon the Flesch Readability Formula (1948). The reading level of the items, including the directions to the P-CARS, was found to be at the 6.3 grade level. In order to further investigate reading level, three additional formulas were applied to the items. A non-computer analysis using the Flesch Index (1948) yielded a reading level of seventh grade. The Dale-Chall Index (1948) yielded a fifth-grade reading level, and the Fog Index (cited in Gunning, 1968) indicated the items could be easily understood by a high school student. Therefore, the instrument can be considered to have an approximate reading level of sixth to seventh grade, and to be appropriate to persons having a secondary level or above education.

The remaining 34 items were again reordered, alternating positive and negative statements in order to avoid subject response set. Presented in Table 2 are the subcomponents of computer anxiety with a revised listing of the items in each category. The P-CARS is shown in Appendix C. It includes the introductory statement, demographic items revised upon recommendations made at the proposal seminar, and the questionnaire. The methodology for the two stages of the final field testing of the instrument is described in the remainder of this chapter.

Table 2

Final Outline of Components of Computer Anxiety

Items	
	I. Feelings of Unresolved Anxiety
1,12	A. Anticipation of negative feelings
3,14	B. Cognitive thoughts accompanied by negative feelings
21,24	C. Acceptance of negative feelings
10,23	D. Avoidance behavior
20,33	E. Avoidance of new learning
11,22	F. Fear of technology
	II. Feelings of Disorientation/Uncertainty
29,32	A. Feelings of confusion
5,18	B. Feelings of being overwhelmed
6, 9	C. Immobilization
	III. Perceived Threat Responses
16,19	A. Lack of confidence
2,27	B. Feelings of inadequacy
7,26	C. Fear of appearing foolish
25,30	D. Negative attitude
	IV. Personification Responses
4,17	A. Fear of replacement
8,31	B. Perception of unlimited power
13,28	C. Perception of ability to reason
15,34	D. Lack of trust

Sample Selection

Administration of the instrument to new groups of examinees was for the purposes of (a) further studying and refining the instrument, and (b) determining the validity, reliability, and factor structure of the instrument. Therefore, two independent samples were chosen for administration of the P-CARS and the resulting CARS. Sample 1 was used for test-retest study, item analysis, analyses of internal consistency reliability, preliminary analyses of subject variables, and preliminary factor analyses of the instrument. Sample 2 was used similarly, as well as to establish criterion-related validity of the final form of the instrument and to examine factor structure. Both samples included students from a public university (University of North Florida) and a private university (Jacksonville University).

The intent of the sampling procedure was to replicate the population characteristics of college students in northern Florida while also approximating population characteristics of college students in general. As discussed in Chapter II, previous studies of computer anxiety have used limited and biased samples of college students. The objectives of the sampling procedures for this study were to avoid similar bias, and to obtain large enough samples for valid factor analyses of the instrument. In order to best achieve these objectives, a cluster sampling procedure was used. According to Weirsema (1985), "Cluster sampling is a name given to

methods of selection in which the sampling unit, the unit of selection, contains more than one population element; the sampling unit is a cluster of elements" (p. 203).

The samples included classes of students across three academic colleges at each university. At the University of North Florida (UNF) the colleges were arts and sciences, business administration, and education and human services. At Jacksonville University (JU) the colleges were arts and sciences, business, and (the division of) education. Every effort was made to select classes which offered maximum opportunity to include a full range of age and academic majors, and which would not be biased in terms of gender. Sample 1 included 256 subjects and Sample 2 included 355 subjects. In each instance, the number of students from each university was approximately proportional to the relative enrollments of each university.

Procedures

Administration of the P-CARS

The P-CARS was administered to 12 classes of students at UNF and JU. Procedures duplicated those of the developmental study, with the elimination of the feedback form. After a period of two weeks, two classes of respondents were requested to complete the questionnaire again for the purpose of establishing test-retest reliability for the instrument.

Data analyses. The demographic profile of the students was analyzed in order to validate the sampling procedures. Characteristics of the sample were compared with the populations of the two universities to determine the extent to which the results may be generalized to the student population of Florida and to students in general.

Means and standard deviations were computed on the item scores to ascertain that each item was eliciting a full range of subject responses. Item-total score correlations were computed to measure the extent to which responses to particular items were related to the trait(s) assessed by the rest of the items on the questionnaire. In order to determine the extent to which each item discriminated among high and low computer anxious individuals, frequencies of response choices for each item were tabulated. A Cronbach alpha coefficient was calculated to examine internal consistency.

Pearson correlation coefficients were calculated to examine the relationships between the total P-CARS score and the demographic characteristics of the sample (e.g., age, gender, previous computer experience, and academic major). Pearson coefficients were also calculated to determine the test-retest reliability of the total score as well as the reliability of individual items.

Intercorrelations of the items were computed to determine if the items chosen for each subcomponent of the P-CARS were (significantly) related prior to factor analyses. However,

the principal statistical procedure applied to the data resulting from the P-CARS was factor analysis, considered a crucial aspect of construct validation (Nunnally, 1967). The use of factor analysis was essential to this study because it provided an explication of the construct of computer anxiety. The primary objective of this approach to test construction was the derivation of scales that were as internally consistent and relatively independent of each other as possible (Walsh & Betz, 1985). An exploratory principal components factor analysis was used initially, followed by both oblique and orthogonal rotations of retained factors to determine as accurate and interpretable factor structure as possible. After further data analyses of the results of the first administration and refinement of the instrument based on the results of the analyses, the final form (CARS) was administered to Sample 2.

Administration of the CARS

Validation studies. The CARS was administered to 14 classes of students at UNF and JU. In order to establish concurrent validity of the CARS, the following four self-report instruments were administered to subgroups of Sample 2 at the time of completion of the questionnaire: Spielberger's State-Trait Anxiety Inventory (STAI) (1970), Suinn's Mathematics Anxiety Rating Scale (MARS) (1972), Spielberger's Test Attitude Inventory (TAI) (1977), and Rotter's Internal-External Control Scale (I-E) (1966).

These instruments were selected on the basis of the relationship between the construct of computer anxiety and the constructs being measured by the four instruments. All four have been the subject of large bodies of research and represent an attempt to broaden the construct of computer anxiety as well as to validate the CARS.

State-Trait Anxiety Inventory

The STAI, developed by Spielberger, Gorsuch, and Lushene (1970) is comprised of separate self-report scales for measuring the distinct anxiety concepts of state anxiety (A-State) and trait anxiety (A-Trait). For the purposes of this study, the A-Trait was used alone because the A-State scale requires subjects to indicate how they feel at a particular moment in time. The A-Trait scale is described in the test manual (Spielberger et al., 1970) as useful for discriminating among subjects who vary in their disposition to respond with different levels of A-State intensity.

The A-Trait scale consists of 20 statements that ask subjects to describe how they generally feel. Instructions are printed on the test form. The response choices are Almost Never, Sometimes, Often, and Almost Always. The examinee responds to each item by blackening the appropriate number (ranging from 1 to 4) to the right of the item statement. It may also be given with an answer sheet to permit machine scoring.

The range of possible scores of the instrument varies from a minimum of 20 to a maximum of 80. Some of the items are worded in such a manner that a rating of 4 indicates a high level of anxiety (e.g., "I feel like crying"), while other items are worded so that a high rating indicates low anxiety (e.g., "I am happy"). The responses are weighted for correct scoring. The scale has seven scoring-reversed STAI items require a fifth or sixth grade reading ability, and 18 of the 20 items must be answered to assure validity of the score.

Normative data for the STAI are available for large samples of undergraduate college students as well as other populations. Test-retest reliabilities for the STAI range from .73 to .86 for college undergraduates, and Cronbach's alpha reliability coefficients for them ranged from .86 to .92. Further evidence of internal consistency was provided by an item-remainder correlation of .55 for college undergraduates.

Concurrent validity studies on the STAI were conducted using the IPAT Anxiety Scale, the Taylor Manifest Anxiety Scale (TMAS), and the Zuckerman Affect Adjective Checklist (AACL). Correlations between the A-Trait scale and the IPAT and the TMAS were moderately high for college students and others. The STAI moderately correlated with the AACL. Indicated in current research for the STAI is evidence that the A-Trait scale is highly correlated with other measures of

trait anxiety, and is a major variable in research which has proved effective with normal adolescents and adults and various patient populations experiencing anxiety.

Test Anxiety Inventory

The TAI was developed by Spielberger, Gonzalez, Taylor, and Anton (1977). It is comprised of 20 items to which subjects are asked to respond on a 4-point scale of Almost Never, Sometimes, Often, and Almost Always. Two subscales, derived by factor analytic procedures, measure the components of emotionality (E) and worry (W).

Alpha reliability coefficients for the TAI total scores were .94 or higher for both males and females. Although the internal consistency for the E and W scales were somewhat lower, alpha coefficients for the subscales were all .86 or higher. The TAI is highly correlated with other widely used test anxiety measures. Further, the W and E subscales are negatively correlated with study skills and have discriminant concurrent validity in the prediction of academic achievement. Presently the TAI is being evaluated in research on the treatment of test anxiety.

Mathematics Anxiety Rating Scale

The MARS, developed by Suinn, Edie, and Nicoletti (1972), is a 98 item self-rating scale which may be administered either individually or to groups. Each item on the scale represents

a situation that may arouse anxiety in the subject. Response choices indicate the degree of anxiety aroused, according to the dimensions of Not at All, A Little, A Fair Amount, Much, or Very Much. Responses are chosen by making a check in the box next to the item reflecting his/her decision. Scoring is conducted by weighting the responses from 1 to 5. The sum of the responses provides the total score for the test.

Test-retest reliability was for the MARS was found to be .78, and an alpha reliability coefficient was found to be .97. The instrument was correlated with the Differential Aptitude Test (DAT) at $r = -.35$ ($p < .05$), suggesting that anxiety as measured by the MARS is associated with low performance on DAT tasks. Further study indicated that MARS scores were inversely correlated with grades in mathematics ($r = -.29$, $p < .001$), and positively correlated with reported dislike of mathematics ($r = .39$, $p < .001$).

The Rotter Internal-External Control Scale

The Rotter (I-E) is a 29-item forced choice scale which requires subjects to choose between an (a) or (b) response to a statement. It is described by Rotter (1966) as an additive scale, that is, the items represent an attempt to sample I-E beliefs across a range of situations such as interpersonal situations, school, government, work, and politics. The author of the scale lays claim to it being a measure of generalized expectancy because it samples a variety of areas.

Test-retest reliability coefficients from several samples vary from .49 to .83, depending on the time interval and the sample involved. Internal consistency reliability was reported by Rotter as ranging from .65 to .79. At the time of writing, the I-E appeared to lack evidence of validity, but subsequently a volume of solid validity data for the scale appeared (Phares, 1976).

Concurrent validity studies have reported strong positive correlations with Externality and anxiety as measured by the Taylor Manifest Anxiety Scale, the Alpert-Haber Facilitating-Debilitating Test Anxiety Questionnaire, and the IPAT Anxiety Scale.

Data analyses. The data from Sample 2 were analyzed by the procedures discussed above (in Sample 1) to establish the extent of valid sampling procedures, to analyze individual items on the CARS, and to study relationships between the total CARS score and the subject variables. Test-retest reliability was examined by Pearson correlation coefficients.

To establish concurrent validity, Pearson correlation coefficients were used to examine any significant relationships between the CARS and the four other instruments administered concurrently.

Forward selection and backward elimination regression procedures were conducted for the dependent variable of CARS

total score in order to identify the best predictors of computer anxiety as measured by the CARS.

Factor analyses of the data were conducted using a preliminary principal components technique, followed by application of oblique and orthogonal rotations until an accurate and interpretable factor structure was identified. Items were ordered within the factors by size of loading to identify concepts underlying the items, and interpretive labels were suggested.

Limitations

Although careful methods of test construction were an essential aspect of this study, potential limitations may be noted in several areas. Sampling procedures, adequacy of the instrumentation, and subject response errors may be considered.

Every attempt was made to sample in clusters adequate to represent the population of college students across academic colleges, and to provide adequate representation in terms of age and gender. The use of volunteer subjects, however, potentially introduced some selection bias because the characteristics of subjects who volunteered may differ from those who did not.

The research procedures also may have introduced potential bias for several reasons. First, administration to subjects in groups may not have assured that each administration

was handled comparably. As the instructors in each class were asked to administer the instrument, the instructors themselves possibly contributed a source of error.

Another potential source for error is the instrument development. Constructs such as attitudes, emotions, and feelings are difficult to measure objectively because they tend to be changeable and sensitive to many factors. As Isaac and Michael (1983, p. 117) point out, two individuals may mark the same response position on a rating scale for different reasons. Such confounding factors could potentially affect the validity of the measuring instrument.

The choice of instruments used for concurrent validity are not necessarily the only appropriate instruments that were available for this purpose. Ease of administration, simplicity of format, and availability to the researcher contributed to the choices, as did the test characteristics previously discussed. The validity and reliability of each instrument potentially limits its adequacy for inclusion in this study.

Additionally, the instruments chosen for concurrent validity, as well as the instrument developed in this study, are self-report, paper-and-pencil measures, and as such, are subject to response bias and faking. Subjects may have contributed error by responding to the items in a less than honest manner.

A final source of error may have been in the computer scoring of all instruments. Although much care was taken by

the researcher to look for stray marks and unreadable responses on each answer sheet, as well as incomplete data, potential existed for error within the response data.

CHAPTER IV

RESULTS

In an effort to develop an instrument suitable for the measurement of computer anxiety, two versions of the Computer Anxiety Rating Scale were administered to classes of students enrolled in three different academic colleges at the University of North Florida (UNF) and Jacksonville University (JU). In Stage One, data were collected from 256 students, using a preliminary form of the CARS (P-CARS), which had been developed during a pilot study. After analyses of the results of that administration, including a preliminary factor analysis, the instrument was revised and data were collected in Stage Two from a new sample of 355 students using the revised form (CARS).

In this chapter, the findings of the study are presented in the following order: (a) P-CARS resulting sample, item analyses, subject variables, reliability, and preliminary factor analysis, and (b) CARS resulting sample, item analyses, subject variables, reliability, validity, factor analysis, and factor structure. The chapter concludes with a section on predictors of computer anxiety.

P-CARS

Resulting Sample

The P-CARS was administered to 268 persons in 12 classes at two universities. Classes included in the sample were from undergraduate courses in English composition, general psychology, American history, biology, property management, real estate finance, database processing, computer data structures, special education, (a graduate course in) counselor education, and two courses in educational methods. Incomplete questionnaires and forms with missing demographic data were excluded from subsequent processing.

The mean P-CARS score for the total sample was 77.2 (σ=20.7), while the mean score for the University of North Florida students was 76.4 (σ=20.9), and the mean score for Jacksonville University students was 81.5 (σ=19.5). The difference between means of the two universities was not statistically significant ($F=2.19$, $p>.14$) however, and the combined classes from the two universities were subsequently treated as one sample.

The resulting sample of 256 included 54 students with a major in the colleges of arts and sciences, 53 with a major in the college of business administration at UNF and the college of business at JU, 113 with a major in the college of education and human services at UNF and the division of education at JU. An additional sample (for comparison

purposes) included 36 students with a major in computer sciences. Males represented 39% of the sample, while females represented 61%. The mean age of the sample was 29, with a standard deviation of 9, and a range of 17 to 64. With regard to age groups, 32% were between the ages of 17 and 22, and 32% were between the ages of 30 and 39. The next largest age group was 20-29 with 22%, followed by 14% over age 40. The sample was bimodal in regards to age, reflecting the differences in populations of the two institutions. Students from the University of North Florida represented 84% of the sample, while students from Jacksonville University represented 16% of the sample. These demographic data approximate those of the combined populations of both institutions, as well as the proportional enrollments, and thus support the generalization of the study to those institutions. The demographic data breakdown for Sample 1 is presented in Table 3.

Responding to the information form question regarding experience with computers, 26% of the sample reported no experience in computer games, 33% reported no experience in word processing, 54% reported no experience in using computers for data management, 65% reported no experience in financial management computing, and 66% reported no experience in statistical analyses. Relatedly, students reporting a great deal of experience were 2% in statistical analysis, 4% in financial management, 9% in data management, 11% in computer games, and

Table 3

Sample 1 Demographic Information

Demographic Variable	Frequency (f)	Percentage (%)
University of North Florida	214	83.6
Jacksonville University	42	16.4
Major by College		
Arts and Science	54	21.1
Business	53	20.7
Education	113	44.1
Computer Science	36	14.1
Total	256	100.0
Age		
17-22	83	32.4
23-29	55	21.5
30-39	82	32.0
Over 40	36	14.1
Total	256	100.0
Gender		
Male	100	39.1
Female	156	60.9
Total	256	100.0

15% in word processing. A detailed breakdown of information regarding computer experience is shown in Table 4.

Item Analyses

Means and standard deviations of the P-CARS items were computed to determine if each item elicited a full range of subject responses. The full range of responses from 1-5 was indicated on each of the 34 items. A low score indicated low anxiety, while a high score indicated high anxiety. Response means of the items ranged from 1.76 to 3.71, and are reported in Table 5. The possible range of a total score on the instrument was 34-170, and the actual range among the 256 subjects was 39-157. The standard errors of the item means ranged from .06 to .08. A Cronbach alpha coefficient was also calculated, yielding an internal consistency coefficient of .94.

Subject variables

The following analyses were related to the research questions (page 10) regarding subject variables of age, previous computer experience, gender, and academic major.

Age. An initial correlation between age of the subjects and total P-CARS score was a negative and statistically non-significant relationship ($r=-.07$, $p > .26$).

Computer experience. All five degree of computer experience variables (i.e., word processing, computer games, data management, financial management, and statistical

Table 4

Sample 1 Computer Experience

Type of Experience	Frequency (f)	Percentage (%)
Word Processing		
0 (None or little)	85	33.2
1	42	16.4
2	48	18.8
3	42	16.4
4 (A great deal)	39	15.2
Computer Games		
0 (None or little)	86	33.6
1	67	26.2
2	48	18.7
3	26	10.2
4 (A great deal)	29	11.3
Data Management		
0 (None or little)	139	54.3
1	35	13.6
2	34	13.3
3	25	9.8
4 (A great deal)	23	9.0
Financial Management		
0 (None or little)	167	65.2
1	34	13.3
2	34	13.3
3	11	4.3
4 (A great deal)	10	3.9
Statistical Analysis		
0 (none or little)	170	66.4
1	35	13.7
2	26	10.2
3	20	7.7
4 (A great deal)	5	2.0

Table 5

P-CARS - Item Means, Standard Deviations, Standard Error of Mean

Item #	Mean	Stn. Dev.	Std. Error of Mean
1	1.99	1.15	.07
2	1.98	1.01	.06
3	2.33	1.11	.07
4	2.34	1.15	.07
5	2.10	.96	.06
6	1.88	1.02	.06
7	2.15	1.08	.07
8	2.04	1.05	.07
9	2.94	1.15	.07
10	1.82	.98	.06
11	2.46	1.16	.07
12	1.77	.96	.06
13	2.81	1.35	.08
14	1.84	.95	.06
15	2.73	1.01	.06
16	2.19	1.17	.07
17	2.36	1.07	.07
18	2.00	.92	.06
19	2.37	1.18	.07
20	2.25	1.03	.06
21	3.71	1.15	.07
22	1.81	.92	.06
23	2.41	1.15	.07
24	2.77	1.10	.07
25	2.22	1.01	.06
26	2.14	1.04	.07
27	2.68	1.16	.07
28	2.14	1.06	.07
29	2.21	1.02	.06
30	2.15	1.09	.07
31	1.98	.95	.06
32	2.34	1.12	.07
33	2.16	1.13	.07
34	2.16	.93	.06
Total score	77.21		

analysis) were significantly negatively correlated with computer anxiety. The following correlations were significant at the .0001 level of confidence: experience with word processing (-.26), computer games (-.27), data management (-.30), and statistical analysis (-.23). Financial management was significant at the .0014 level of confidence (-.20).

Gender. Males in the total sample showed a mean score of 72.1 (σ=20.3), while females had a mean score of 80.5 (σ=20.4). This difference was found to be statistically significant (F=10.45, p <.0014).

Academic major. Computer majors indicated a mean score of 59.4 (σ=19.4), business majors indicated a mean score of 75.4 (σ=17.6), education majors indicated a mean score of 80.7 (σ=20.4), and arts and sciences majors indicated a mean score of 83.7 (σ=18.5). Analyses of variance indicated significant differences among the means (F=13.61, p <.0001). A Scheffé application revealed a significant difference in computer anxiety between computer majors and each of the remaining categories of majors, but no significant differences among the three academic majors. The results of the differences among academic major are presented in Table 6.

Reliability

Thirty-five students from Jacksonville University were scheduled to complete the P-CARS a second time, two weeks

Table 6

Comparison of Academic Major and P-CARS Score

Academic Major	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
Comparison			
0 - 1	-35.988	-24.287	-12.586 *
0 - 3	-31.728	-21.320	-10.913 *
0 - 2	-27.761	-16.016	-4.272 *
1 - 3	-6.029	2.967	11.963
1 - 2	-2.244	8,271	18.785
1 - 0	12.486	24.287	35.988 *
2 - 1	-18.785	-8.271	2.244
2 - 3	-14.357	-5.304	3.749
2 - 0	4.272	16.016	27.761 *
3 - 1	-11.963	-2.967	6.029
3 - 2	-3.749	5.304	14.357
3 - 0	10.913	21.320	31.728 *

Note. 0 = Computer science majors
1 = Arts and Sciences majors
2 = Business majors
3 = Education majors

* $p < .05$

after the first administration. Due to problems in scheduling and absenteeism, a total of 22 students completed the second testing. The sample was composed of 13 females and 9 males. Thirty-six percent were in the 17-22 age group, while 64% were in the 23-29 age group. A Pearson correlation yielded a total score reliability of .94, significant at the .0001 level of confidence. The test-retest reliabilities for all 34 items are shown in Table 7. Correlations ranged from .09 to .88. Thirteen correlations were significant at the .0001 level of confidence, 10 correlations were significant at the .001 level, and 4 were significant at the .05 level. Six were not significant correlations.

Factor Analysis

Intercorrelations of all items were calculated prior to factor analysis, and are presented in Table 8. In order to extract maximum variance from the data set, an exploratory principal components analysis was applied to the 34 items of the P-CARS. Using the Mineigen criterion (i.e., Eigenvalue > 1.0), six factors were retained. Both orthogonal (varimax) and oblique (promax) rotation methods were conducted in order to determine the most accurate, as well as interpretable, factor structure of the preliminary items.

Following an orthogonal rotation, two well-defined factors were present, with 22 and 10 items respectively, having salient loadings of .40 or higher (Gorsuch, 1974, p. 192). In regard

Table 7

Test-Retest Reliabilities of P-CARS Items
Pearsonian r for Two-Week Interval

Item #	Correlation (r)
1	.84 ***
2	.70 **
3	.88 ***
4	.69 **
5	.51 *
6	.71 **
7	.87 ***
8	.73 **
9	.83 ***
10	.61 *
11	.33
12	.87 ***
13	.67 **
14	.78 ***
15	.78 ***
16	.77 ***
17	.62 *
18	.48 *
19	.90 ***
20	.77 ***
21	.25
22	.26
23	.44 *
24	.51 *
25	.26
26	.87 ***
27	.89 ***
28	.09
29	.68 **
30	.72 **
31	.79 ***
32	.40
33	.71 **
34	.22

Note. $N = 22$

* $p < .05$ ** $p < .001$ *** $p < .0001$

Table 8

Intercorrelations of P-CARS Items 1-34

Item	1	2	3	4	5	6
1	--					
2	.66**	--				
3	.50**	.56**	--			
4	.29**	.35**	.36**	--		
5	.37**	.43**	.48**	.35**	--	
6	.67**	.59**	.42**	.35**	.39**	--
7	.49**	.55**	.56**	.40**	.48**	.39**
8	.47**	.48**	.35**	.54**	.38**	.55**
9	.64**	.61**	.54**	.38**	.49**	.56**
10	.50**	.54**	.50**	.39**	.38**	.53**
11	.47**	.42**	.53**	.25**	.37**	.34**
12	.63**	.63**	.49**	.33**	.38**	.67**
13	.07	.09	.18	.14	.03	.01
14	.67**	.62**	.47**	.42**	.39**	.74**
15	.27**	.23*	.33**	.17	.33**	.15
16	.71**	.64**	.47**	.35**	.35**	.66**
17	.09	.03	.24**	.31**	.15	.12

* p <.001 ** p < .0001

Table 8, continued

Item	7	8	9	10	11	12
1						
2						
3						
4						
5						
6						
7	--					
8	.41**	--				
9	.52**	.49**	--			
10	.47**	.48**	.54**	--		
11	.44**	.31**	.54**	.39**	--	
12	.46**	.54**	.55**	.62**	.49**	--
13	.11	.04	.11	.07	.14	.11
14	.48**	.57**	.55**	.60**	.40**	.67**
15	.32**	.11	.30**	.24**	.33**	.21**
16	.46**	.49**	.66**	.52**	.47**	.65**
17	.15	.16	.14	.16	.10	.15

* $\underline{P} < .001$ ** $\underline{P} < .0001$

Table 8, continued

Item	13	14	15	16	17
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13	--				
14	.05	--			
15	-.08	.24**	--		
16	.10	.64**	.24**	--	
17	.06	.16*	.17*	.14	--

* $p < .001$ ** $p < .0001$

Table 8, continued

Item	1	2	3	4	5	6
18	.60**	.62**	.48**	.41**	.39**	.56**
19	.72**	.58**	.49**	.37**	.46**	.62**
20	.36**	.41**	.49**	.45**	.35**	.31**
21	-.58**	-.58**	-.43**	-.37**	-.42**	-.58**
22	.39**	.43**	.29**	.37**	.33**	.42**
23	.41**	.43**	.50**	.27**	.29**	.31**
24	.12	.09	.19	.17	.09	.14
25	.46*	.48**	.59**	.31**	.41**	.42**
26	.52**	.49**	.36**	..36**	.29**	.59**
27	.66**	.63**	.52**	.34**	.48**	.60**
28	.02	.22	-.03	.06	.06	.18
29	.64**	.58**	.45**	.40**	.44**	.64**
30	.58**	.53**	.57**	.31**	.35**	.52**
31	.16	.24**	.17	.13	.15	.10
32	.64**	.63**	.43**	.43**	.42**	.65**
33	.25**	.27**	.48**	.11	.21*	.18
34	.34**	.30**	.30**	.33**	.35**	.26**

* $p < .001$ ** $p < .0001$

Table 8, continued

Item	7	8	9	10	11	12
18	.48**	.58**	.55**	.51**	.45**	.63*&
19	.53**	.55**	.73**	.50**	.50**	.61**
20	.45**	.34**	.39**	.45**	.41**	.37**
21	-.41**	-.49**	-.65**	-.48**	-.40**	-.59**
22	.33**	.40**	.45**	.40**	.32**	.45**
23	.46**	.29**	.43**	.43**	.41**	.40**
24	.19	.18	.13	.21*	.13	.11
25	48**	.38**	.49**	.58**	.56**	.47**
26	.32**	.55**	.53**	.45**	.32**	.56**
27	.49**	.48**	.78**	.48**	.52**	.55**
28	-.01	.16	-.06	.11	-.06	.10
29	.50**	.54**	.65**	.49**	.44**	.62**
30	.51**	.40**	.59**	.52**	.53**	.51**
31	.19	.16	.19*	.23*	.20*	.19*
32	.45**	.51**	.68**	.55**	.41**	.65**
33	.37**	.17	.30**	.33**	.40**	.27**
34	.27**	.31**	.39**	.34**	.32**	.29**

* $\underline{p} < .001$ ** $\underline{p} < .0001$

Table 8, continued

Item	13	14	15	16	17
18	.12	.65**	.22*	.60**	.16
19	.06	.65**	.32**	.77**	.17
20	.11	.44**	.29**	.37**	.16
21	-.02	-.59**	-.22*	-.60**	-.02
22	.13	.43**	.14	.42**	.17
23	.12	.39**	.33**	.37**	.21*
24	-.04	.12	.09	.07	.06
25	.05	.59**	.43**	.47**	.27**
26	-.05	.62**	.16	.58**	.15
27	.08	.58**	.31**	.67**	.10
28	-.03	.19	-.13	.05	.08
29	.02	.67**	.32**	.69**	.19
30	.01	.55**	.44**	.58**	.15
31	.16	.20*	.17	.13	.21*
32	.10	.63*	.25**	.74**	.13
33	.09	.25**	.34**	.15	.16
34	.11	.37**	.29**	.30**	.14

* $\underline{p} < .001$ ** $\underline{p} < .0001$

Table 8, continued

Item	18	19	20	21	22	23
18	--					
19	.59**	--				
20	.46**	.40**	--			
21	-.52**	-.63**	-.40**	--		
22	.51**	.38**	.31**	-.37**	--	
23	.41**	.44**	.41**	-.37**	.31**	--
24	.10	.12	.27**	-.18	.06	.19*
25	.45**	.52**	.51**	-.43**	.34**	.49**
26	.51**	.57**	.34**	-.59**	.37**	.30**
27	.56**	.73**	.40**	-.59**	.42**	.42**
28	.12	.01	-.08	-.12	.10	-.03
29	.60**	.73**	.41**	-.58**	.42**	.41**
30	.54**	.63**	.47**	-.55**	.31**	.49**
31	.16	.17	.20	-.12	.17	.27**
32	.64**	.72**	.38**	-.65**	.43**	.39**
33	.33**	.23*	.29**	-.20*	.26**	.44**
34	.32**	.37**	.38**	-.38**	.30**	.28**

* $p < .001$ ** $p < .0001$

Table 8, continued

Item	24	25	26	27	28	29
18						
19						
20						
21						
22						
23						
24	--					
25	.26**	--				
26	.11	.42**	--			
27	.08	.54**	.56**	--		
28	-.03	.04	.21*	-.03	--	
29	.11	.49**	.54**	.71**	.00	--
30	.18	.65**	.49**	.62**	-.02	.60**
31	.03	.28**	.07	.18	.09	.23*
32	.09	.46**	.60**	.70**	.09	.74**
33	.15	.50**	.07	.25**	-.10	.31**
34	.24**	.37**	.30**	.36**	.01	.38**

* $p < .001$ ** $p < .0001$

Table 8, continued

Item	30	31	32	33	34
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30	--				
31	.18	--			
32	.61**	.17	--		
33	.44**	.24**	.24**	--	
34	.41**	.26**	.40**	.22*	--

* $p < .001$ ** $p < .0001$

to the other four factors, Factor 3 included 2 items with loadings of .40 or higher, and Factor 4 included 3 items with loadings of .40 or higher. Factors 5 and 6 each included one item with a factor loading greater than .40.

Following an oblique rotation, the first two factors included 26 and 20 items, respectively, with salient loadings of .40 or higher, including that loaded at that level on both factors. Factor 3 included 9 items with loadings of .40 or higher, while Factor 4 included 6 items with loadings of .40 or higher. Factors 5 and 6 each included one item with a factor loading greater than .40.

The oblique rotation inter-factor correlations were Factors 1 and 2 (.47), Factors 1 and 3 (.40), and Factors 1 and 4 (.39). Factors 2 and 3 were also positively correlated (.32). Correlations in excess of .30 indicated a 10% or more overlap in variance among the factors (Tabachnick & Fidell, 1983), suggesting complex rather than simple structure among the variables (items). Although the oblique rotation appeared to be an appropriate representation of the factor structure, due to the overlap in variance interpretation of the factors was a practical disadvantage. The difference between high and low values was considerably more apparent in the (orthogonal) pattern matrix than in the (oblique) structure matrix, permitting better conceptualization of the factors.

Moreover, examination of the varimax rotated factor pattern revealed only 7 of the 34 items had salient loadings

(i.e., >.40) on more than one factor, and none loaded on more than two factors. Therefore, interpretation of the factors and ease of description were more appropriately expedited by the varimax rotation.

Examination of the rotated factor pattern indicated that Factors 5 and 6 each included only one item with a salient loading of .40 or higher, and the items did not have salient loadings on any other factor. Consequently, these factors were considered insufficiently defined, and on this basis the two items were eliminated (items 13 and 28). Two additional items (21 and 24,) which did not load on any of the factors, were also eliminated. This preliminary factor analysis indicated that the remaining 30-item set appeared to define at least four factors. Therefore, these items comprised the second revision of the instrument (CARS). Presented in Table 9 are the factor loadings following a principal components factor analysis with orthogonal rotation.

CARS

The elimination of 4 items in P-CARS necessitated a re-numbering of several items. A Table of Correspondence (see Table 10) was used to present the relationship between item numbers. The final form of the CARS is presented in Appendix D.

Table 9

Primary Factor Loadings for P-CARS Items Following a Principal Components Factor Analysis With an Orthogonal Rotation

Item	Factors 1	2	3	4	5	6	Communality
1	.78*	.27	.02	.01	-.04	.01	.69
2	.72*	.32	-.01	.07	.06	.14	.66
3	.43*	.58*	.12	.20	-.10	.13	.61
4	.38	-.04	.55*	.44*	-.03	.21	.70
5	.55*	.21	.36	.13	-.17	-.02	.42
6	.80*	.10	.01	.09	.21	-.04	.70
7	.46*	.44*	.14	.22	-.12	.12	.51
8	.62*	.00	.27	.31	.18	.08	.60
9	.74*	.26	.14	.05	-.24	.06	.72
10	.54*	.40*	.09	.28	.20	.06	.59
11	.42*	.54*	.03	.07	-.19	.10	.53
12	.73*	.28	.01	.08	.18	.11	.67
13	.02	.11	.05	-.04	-.08	.84*	.73
14	.75*	.24	.12	.15	.24	-.01	.72
15	.16	.49*	.31	-.02	-.31	-.38	.62
16	.84*	.15	.05	-.01	-.06	.03	.73
17	.01	.17	.74*	-.05	.14	-.03	.61
18	.68*	.26	.12	.14	.11	.17	.62
19	.81*	.22	.14	.03	-.16	-.04	.76

* Items loading .40 or higher

Table 9, continued

Item	1	2	Factors 3	4	5	6	Communality
20	.32	.36	.22	.50*	-.14	.11	.57
21	-.73	-.13	-.02	-.23	.00	.04	.62
22	.47*	.15	.26	.08	.12	.27	.41
23	.31	.60*	.12	.13	.00	.09	.50
24	.00	.18	-.07	.78*	.02	-.11	.67
25	.40*	.66*	.19	.22	.04	-.11	.70
26	.72*	.00	.13	.17	.17	-.14	.63
27	.78*	.25	.11	-.01	-.22	.00	.74
28	.12	-.07	.10	-.03	.78*	-.05	.65
29	.77*	.23	.21	.01	-.08	-.05	.70
30	.58*	.52*	.08	.14	-.11	-.16	.68
31	.04	.43*	.38	-.17	.22	.20	.46
32	.82*	.15	.14	.03	-.04	.04	.73
33	.07	.78*	.02	.05	.00	.03	.63
34	.30	.20	.40	.32	.14	.02	.40

* Items loading .40 or higher

Table 10

Table of Correspondence for P-CARS and CARS Items

P-CARS Items	CARS Items
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	Eliminated
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	Eliminated
22	22
23	13
24	Eliminated
25	23
26	24
27	25
28	Eliminated
29	21
30	26
31	27
32	28
33	29
34	30

Resulting Sample

The CARS was administered to a second sample of 371 persons in 14 classes at the two universities. Classes included in the sample were statistics for business management, economics, human growth and development, English composition, social psychology, general psychology, political science, sociology, business management, and graduate courses in educational organization and administration, interpersonal skills, and consultation. Incomplete questionnaires and forms with missing demographic data were excluded, resulting in a final sample of 355 persons.

Four self-report instruments were administered to subgroups of the sample at the time of completion of the CARS. The State-Trait Anxiety Inventory (STAI) was completed by 91 students, the Mathematics Anxiety Rating Scale (MARS) was completed by 54 students, the Test Attitude Inventory (TAI) was completed by 127 students, and 83 students completed the Internal-External Control Scale (I-E). A description of the characteristics of each subgroup is given in the findings regarding validity.

The mean CARS total score for the total sample was 70.24 (σ=19.24), while the mean total score for the University of North Florida students was 69.9 (σ=19.8) and the mean total score for Jacksonville University students was 71.2 (σ=17.3). Substantiating the findings from Sample 1, the difference between means of the two universities was not statistically

significant ($F=.23$, $p>.63$), and the students from the two universities were treated as one sample.

The resulting sample of 355 included 132 students with a major in the colleges of arts and sciences, 116 with a major in the college of business administration (UNF) and the college of business (JU), and 107 with a major in the college of education and human services (UNF) and the division of education (JU). Males comprised 38% of the sample, and 62% were female. The mean age was 25, with a standard deviation of 7 and a range of 17 to 54. The largest age group was 17-22 (51.8%), followed by 23-29 with 24.5%. The 30-39 age group comprised 17.8%, followed by 5.9% for the over age 40 group. University of North Florida students represented 78% of the sample, while Jacksonville University students represented 22% of the sample. The sample approximated the combined populations of the institutions and represented the proportional enrollments, thus supporting the generalizability of the study to those institutions. The demographic data breakdown for Sample 2 is presented in Table 11.

Regarding experience with computers, 30% reported no experience in computer games, 32% reported no experience in word processing, 59% reported no experience in using computers for data management, 65% reported no experience in using computers for statistical analyses, and 69% reported no experience in financial management computing. Relatedly, students reporting a great deal of experience were .8% in

Table 11

Sample 2 Demographic Information

Demographic Variable	Frequency (f)	Percentage (%)
University of North Florida	277	78.0
Jacksonville University	78	22.0
Major by College		
Arts and Science	132	37.2
Business	116	32.7
Education	107	30.1
Total	355	100.0
Age		
17-22	184	51.8
23-29	87	24.5
30-39	63	17.8
Over 40	21	5.9
Total	256	100.0
Gender		
Male	133	37.5
Female	222	62.5
Total	256	100.0

statistical analyses, 3% in financial management, 3% in data management, 10% in computer games, and 10% in word processing. A detailed data breakdown of information regarding respondents' computer experience is shown in Table 12.

Item Analyses

The full range of responses from 1-5 was indicated on each of the 30 CARS items. One indicated low anxiety while five indicated high anxiety. Means and standard deviations of the items were computed. Item means ranged from 1.92 to 3.01 as reported in Table 13. The possible range of total score on the instrument was 30-130, and the actual range among the 355 subjects was 30-130. The standard errors of the means ranged from .04 to .06. A Cronbach alpha coefficient for internal consistency was .94.

Subject variables

Age. Contrary to the findings in the first stage of the study, age of the subjects was found to be significantly and negatively correlated with computer anxiety ($r=-.12$, $p<.02$) for this sample.

Computer experience. Supporting the findings related to the P-CARS, all five degree of computer experience variables (word processing, computer games, data management, financial management, and statistical analysis) were significantly negatively correlated with computer anxiety. The following

Table 12

Sample 2 Computer Experience

Type of Experience	Frequency (f)	Percentage (%)
Word Processing		
0 (None or little)	113	31.8
1	59	16.6
2	92	23.1
3	67	18.9
4 (A great deal)	34	9.6
Computer Games		
0 (None or little)	105	29.6
1	85	23.9
2	95	26.8
3	33	9.3
4 (A great deal)	37	10.4
Data Management		
0 (None or little)	210	59.2
1	53	14.9
2	51	14.4
3	31	8.7
4 (A great deal)	10	2.8
Financial Management		
0 (None or little)	246	69.3
1	38	10.7
2	35	9.9
3	25	7.0
4 (A great deal)	11	3.1
Statistical Analysis		
0 (none or little)	229	64.4
1	58	16.3
2	43	12.1
3	22	6.2
4 (A great deal)	3	0.8

Table 13

CARS--Item Means, Standard Deviations, Standard Error of Means

Item #	Mean	Stn. Dev.	Std. Error of Mean
1	2.13	1.05	.05
2	2.18	.96	.05
3	2.57	1.12	.05
4	2.58	1.17	.06
5	2.27	.88	.04
6	2.03	1.03	.05
7	2.39	1.11	.05
8	2.25	.97	.05
9	3.01	1.12	.06
10	1.93	.93	.05
11	2.62	1.15	.06
12	1.88	.91	.04
13	2.51	1.11	.05
14	2.00	.95	.05
15	2.94	1.04	.05
16	2.31	1.07	.05
17	2.51	1.09	.05
18	2.05	.85	.04
19	2.45	1.09	.05
20	2.42	1.04	.05
21	2.29	.95	.05
22	2.02	1.04	.05
23	2.23	.96	.05
24	2.41	1.12	.06
25	2.78	1.07	.05
26	2.28	1.09	.05
27	2.32	.95	.05
28	2.44	1.06	.05
29	2.21	1.06	.05
30	2.09	.83	.04
Total score	77.21		

correlations were significant at the .0001 level of confidence: word processing (-.47), computer games (-.31), data management (-.45), financial management (-.35), and statistical analysis (-.34).

Gender. A mean score of 65.2 (σ=19.9) was calculated for males in the sample and a mean score of 73.3 (σ=18.2) was calculated for females. This difference was statistically significant (F=15.10, p<.0001), supporting the findings from the first phase of the study that females scored significantly higher in computer anxiety than did males.

Academic major. Arts and science majors had a mean total score of 73.9 (σ=18.0) on the CARS, education majors had a mean total score of 73.6 (σ=19.2), while those students majoring in business indicated a mean total score of 63.5 (σ=18.9). Contrary to the findings from the first phase of the study, based on an analysis of variance there were significant differences in the second phase among academic majors (F=8.1, p<.0001). A Scheffé comparison revealed business majors scored significantly lower than arts and science majors and education majors (see Table 14).

Reliability

Following a two-week period, twenty students completed the CARS a second time. This sample was composed of 10 females and 10 males. A Pearson correlation coefficient yielded a retest reliability of .83, significant at the .0001 level of

Table 14

Comparison of Academic Major and CARS Score

Academic Major	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
Comparison			
1 - 2	3.607	10.363	17.119 *
1 - 3	-6.658	0.244	7.146
2 - 1	-17.119	-10.363	-3.607 *
2 - 3	-17.156	-10.119	-3.082 *
3 - 1	-7.146	-0.244	6.658
3 - 2	3.082	10.119	17.156 *

Note. 1 = Arts and Sciences majors
2 = Business majors
3 = Education majors

* $p < .05$

confidence. Reliabilities of the items are reported in Table 15. Individual item reliability coefficients ranged from .12 to .86; 7 were significant at the .0001 level of confidence, 7 at the .001 level, and 9 at the .05 level. Seven items did not have statistically significant reliability coefficients.

Validity

Preceding examination of the validity of the CARS, an analysis of variance was conducted to determine if differences existed in computer anxiety scores among the sub-groups. Following an indication of significant differences ($F=7.85$, $p < .0001$), a Scheffe test of comparison demonstrated that the MARS subgroup scored significantly lower on the CARS than did the other subgroups. The MARS subgroup was composed primarily of college of business majors who in this sample were found to score lower in computer anxiety than other college majors. Scheffe comparisons for these data are shown in Table 16.

In order to examine the concurrent validity of the CARS, correlations were computed for each subgroup between scores on it and scores on each of the four instruments. These results are reported in Table 17. In addition, correlations between the individual CARS items and each instrument were calculated to examine item validity and are presented in Table 18.

Table 15

Test-Retest Reliabilities of CARS Items
Pearsonian r for Two-Week Interval

Item #	Correlation (r)
1	.70 **
2	.50 *
3	.41
4	.60 *
5	.64 *
6	.65 **
7	.52 *
8	.77 ***
9	.79 ***
10	.78 ***
11	.12
12	.39
13	.34
14	.40
15	.39
16	.50 *
17	.83 ***
18	.21
19	.47 *
20	.72 **
21	.45 *
22	.47 *
23	.76 ***
24	.52 *
25	.68 **
26	.73 **
27	.37
28	.85 ***
29	.86 ***
30	.51 *

Note. $N = 20$

* $p < .05$ ** $p < .001$ *** $p < .0001$

Table 16

Comparison of CARS Score Among Sub-Groups

Subgroup Comparison	Lower Confidence Limit	Difference Between Means	Upper Confidence Limit
STAI - IE	-12.803	-4.826	3.151
STAI - TAI	-11.564	-4.346	2.872
STAI - MARS	0.102	9.130	18.158 *
TAI - IE	-7.898	-0.480	6.938
TAI - STAI	-2.872	4.345	11.564
TAI - MARS	4.939	13.477	22.015 *
IE - TAI	-6.938	0.480	7.898
IE - STAI	-3.151	4.826	12.803
IE - MARS	4.768	13.956	23.145 *
MARS - IE	-23.145	-13.956	-4.768 *
MARS - TAI	-22.015	-13.477	-4.939 *
MARS - STAI	-18.158	-9.130	-0.102 *

* $p < .05$

Table 17

Pearson Correlation Coefficients Between CARS and STAI, TAI, MARS, and I-E

	STAI	TAI	MARS	I-E
CARS	.41 .0001 N=91	.09 .3040 N=127	.74 .0003 N=54	.17 .1138 N=83

Table 18

Correlations Between CARS Items and STAI, TAI, MARS, and I-E (Independent Samples)

Item #	STAI (N=91)	TAI (N=127)	MARS (N=54)	I-E (N=83)
1	.25*	.09	.04	.02
2	.44***	.11	.19	.20
3	.28*	-.14	.54***	.24*
4	.18	-.05	.40*	.11
5	.16	.04	.36*	.24*
6	.09	.11	.34*	.03
7	.22*	.05	.33*	.16
8	.31*	.16*	.24	.09
9	.27*	.05	.25	-.08
10	.25*	.11	.25	-.04
11	.30*	.06	.36*	.25*
12	.27*	.20*	.28*	-.01
13	.24*	-.17	.16	.23*
14	.24*	.12	.37*	.14
15	.25*	-.16	.20	.25*
16	.33**	.10	.37*	.06
17	.22*	-.08	.43**	.15
18	.34**	.10	.31*	.02
19	.26*	.03	.26*	.00
20	.22*	.03	.53***	.12
21	.24*	.12	.16	.00
22	.34**	.23*	.22	.21*
23	.17	.00	.23	.20
24	.29*	.12	.39*	.10
25	.33**	.06	.25	-.04
26	.32*	.00	.39*	.06
27	.10	.12	.23	.13
28	.32*	.15	.38*	-.04
29	.28*	.02	.17	.16
30	.31*	.17*	.37*	-.06

Note. Subgroups are independent samples and of different sizes.

* $p < .05$ ** $p < .001$ *** $p < .0001$

State-Trait Anxiety Inventory

Resulting sample. A total of 91 students completed the STAI in addition to the CARS. Sixty-four percent were enrolled at the University of North Florida and 36% were enrolled at Jacksonville University. Males comprised 54% of the sample and females comprised 46%. The largest age group was 23-29, representing 68%, followed by the 17-22 age group, with 19%.

The 30-39 age group represented 10%, with 4% falling in the category over age 40. Thirty-eight percent were majors in the college of arts and sciences, 55% were majors in the college of business, and the college of education represented 7%.

Relationship between CARS and STAI. The CARS total score and total score on the STAI were significantly and positively correlated ($r=.41, p<.0001$), indicating a direct relationship between computer anxiety and trait anxiety. The mean score on the STAI was 38.8 ($\sigma=8.9$), well within the "normal" range for the instrument. Item correlations between the CARS and the STAI indicated one item significantly correlated at the .0001 level of confidence, five items correlated at the .01 level, and 19 items at the .05 level.

Test Anxiety Inventory

Resulting sample. The TAI was completed by 127 students, 65% enrolled at the University of North Florida and 35% enrolled at Jacksonville University. Males comprised 28% of

the sample, while females comprised 72%. The largest age group was 23-29, representing 50% of the sample, followed by the 17-22 age group with 30%. The 30-39 age group represented 17%, followed by 4% in the over age 40 group. Arts and sciences majors comprised 65% of the sample, business majors 9% of the sample, and education majors 26% of the sample.

Relationship between CARS and TAI. The CARS total score and total score on the TAI were not significantly correlated ($r=.09$, $p > .30$), indicating no relationship between computer anxiety and test anxiety. Item correlations showed three CARS items correlated at the .05 level of confidence with the TAI, while the remainder of the items did not have significant relationships.

Mathematics Anxiety Rating Scale

Resulting sample. The MARS was completed by 54 students. Sixty-five percent were male and 35% were female. The largest age group represented in the sample was the 23-29 age group with 65%, followed by 24% in the 30-39 age group, and 11% in the over age 40 group. No students were in the 17-22 age group. Nearly all the subjects were business majors (98%); only 2% were arts and sciences majors.

Relationship between CARS and MARS. Computer anxiety and math anxiety were found to be significantly and positively correlated ($.47, p < .0003$). Two CARS items were correlated with the MARS at the .0001 level of significance, one item was

correlated at the .001 level, and 15 items were correlated at the .05 level.

Rotter Internal-External Locus of Control Scale

Resulting sample. The I-E Scale was completed by a total of 83 students at the University of North Florida. Females comprised 83% of this sample and males comprised 17% of this sample. With regards to age, 68% were in the 23-29 age group and 24% in the 30-39 age group. Those over age 40 represented 7% of the sample and the 17-22 age group represented 1% of the sample. A large portion were education majors (82%), while 16% were arts and sciences majors and 2% were business majors.

Relationship between CARS and I-E. No significant relationship was found between computer anxiety and locus of control. A Pearson correlation yielded a relationship of .17 (p >.11). CARS item correlations yielded six items significantly correlated to the I-E Scale at the .05 level of confidence. The remainder of the items were not significantly correlated with the I-E Scale.

Factor Analysis

Intercorrelations of all items were calculated prior to factor analysis, and are presented in Table 19. A factor analysis of the 30 item form of the CARS, using the principle components method, yielded 5 factors based on the Mineigen criterion of Eigenvalues > 1.0. As in the first phase of the

Table 19

Intercorrelations of CARS Items 1-30

Item	1	2	3	4	5	6
1	--					
2	.55**	--				
3	.41**	.45**	--			
4	.20**	.28**	.22**	--		
5	.42**	.45**	.38**	.28**	--	
6	.52**	.51**	.38**	.25**	.47**	--
7	.46**	.44**	.42**	.29**	.42**	.43**
8	.33**	.39**	.24**	.46**	.34**	.44**
9	.50**	.48**	.43**	.23**	.47**	.51**
10	.56**	.52**	.43**	.32**	.37**	.51**
11	.39**	.30**	.48**	.20**	.33**	.30**
12	.53**	.41**	.34**	.33**	.32**	.54**
13	.34**	.33**	.44**	.15	.36**	.31**
14	.54**	.47**	.39**	.28**	.43**	.57**
15	.29**	.31*	.38**	.14	.25**	.18*

* $p < .001$ ** $p < .0001$

Table 19, continued

Item	7	8	9	10	11	12
1						
2						
3						
4						
5						
6						
7	--					
8	.38**	--				
9	.45**	.42**	--			
10	.47**	.42**	.44**	--		
11	.37**	.35**	.42**	.36**	--	
12	.39**	.39**	.46**	.59**	.36**	--
13	.35**	.19*	.38**	.34**	.37**	.32**
14	.54**	.47**	.39**	.28**	.43**	.57**
15	.29**	.31**	.38**	.14	.25**	.18*

* $\underline{P} < .001$ ** $\underline{P} < .0001$

Table 19, continued

Item	13	14	15
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13	--		
14	.30**	--	
15	.22*8	.30**	--

* $p < .001$ ** $p < .0001$

Table 19, continued

Item	1	2	3	4	5	6
16	.58**	.58**	.39**	.29**	.43**	.60**
17	.02	.13	.16*	.40**	.15	.09
18	.42**	.53**	.31**	.29**	.36**	.45**
19	.67**	.54**	.45**	.25**	.50**	.56**
20	.41**	.38**	.38**	.27**	.39**	.34**
21	.61**	.44**	.39**	.22**	.44**	.57**
22	.23**	.34**	.19*	.12	.15	.29**
23	.52**	.51**	.56**	.22**	.48**	.39**
24	.47**	.47**	.35**	.26**	.40**	.52**
25	.62**	.53**	.42**	.23**	.45**	.54**
26	.53**	.53**	.54**	.18*	.46**	.46**
27	.13	.13	.14	.09	.22**	.10
28	.54**	.55**	.39**	.31**	.41**	.56**
29	.12	.19*	.28**	.00	.22**	.08
30	.30**	.34**	.27**	.28**	.33**	.28**

* $p < .001$ ** $p < .0001$

Table 19, continued

Item	7	8	9	10	11	12
16	.48**	.49**	.55**	.59**	.41**	.57**
17	.16*	.29**	.16*	.05	.15	.11
18	.42**	.45**	.41**	.54**	.26**	.49**
19	.51**	.38**	.60**	.53**	.42**	.52**
20	.43**	.28**	.34**	.50**	.31**	.35**
21	.41**	.40**	.50**	.49**	.36**	.55**
22	.23**	.24**	.26**	.25**	.23**	.25**
23	.45**	.30**	.41**	.49**	.50**	.39**
24	.40**	.40**	.44**	.43**	.32**	.51**
25	.45**	.39**	.69**	.48**	.41**	.48**
26	.48**	.29**	.45**	.57**	.46**	.45**
27	.12	.13	.20**	.14	.08	.13
28	.45**	.43**	.52**	.47**	.32**	.54**
29	.25**	.08	.20**	.18*	.19*	.12
30	.37**	.31**	.32**	.32**	.28**	.36**

* $\underline{p} < .001$ ** $\underline{p} < .0001$

Table 19, continued

Item	13	14	15
16	.30**	.69**	.33*
17	.12	.09	.07
18	.23**	.58**	.24**
19	.39**	.61**	.35**
20	.35**	.49**	.29**
21	.32**	.60**	.28**
22	.11	.30**	.18*
23	.39**	.44**	.46**
24	.29**	.55**	.20**
25	.32**	.53**	.35**
26	.41**	.56**	.42**
27	.18*	.19*	.11
28	.32**	.61**	.30**
29	.35**	.15	.23**
30	.26**	.37**	.23**

* $\underline{p} < .001$ ** $\underline{p} < .0001$

study, both orthogonal (varimax) and oblique (promax) rotations were conducted in order to determine the most accurate and interpretable factor structure of the items.

Following an orthogonal rotation, two well-defined factors were present, with a respective 16 and 7 items, of salient loadings of .40 or higher. Factors 3 and 4 included 3 items with loadings of .40 or higher, and Factor 5 had one item with a salient loading.

An oblique rotation with 5 factors indicated inter-factor correlations between Factors 1 and 2 (.54), Factors 1 and 3 (.31), and Factors 2 and 4 (.34). Supporting the findings of the factor analysis in the first phase of the study, these correlations (in excess of .30) indicated an overlap in variance among the factors. However, identical items had loadings of .40 or more on the five factors following both varimax and oblique rotations. Consequently, an orthogonal rotation was retained for ease of interpretation and conceptual simplicity.

The items were factored again using orthogonal rotation for four factors. Two factors were even more clearly defined, with 20 and 8 items, respectively, loading .40 or higher. Factors 3 and 4 each contained 3 items with salient loadings. This solution was determined to be the most clear-cut, and revealed only 4 of the 30 items to have complex structure. Three of these items loaded on both Factors 1 and 2, and one

item loaded on Factors 1 and 3. The rotated factor pattern is shown in Table 20.

The greater the overlap between an item and a factor, the more the item is a pure measure of the factor. Comrey (1973) suggested that loadings in excess of .71 (i.e., approximately 50% variance) are considered excellent, .63 (40%) very good, .55 (30%) good, and .45 (20%) fair. According to these guidelines, 13 of the 30 CARS items were excellent measures of their respective factor, 4 were very good, and 6 were good. Six items were fair measures. According to Comrey, one item (#5) was a poor item, although it loaded .41 on Factor 1 and .40 on Factor 2.

In an attempt to define the factors in more detail, factor analytic procedures were applied separately to the data for males and females. With an initial principal components method and using the critical value of an eigenvalue >1.0, 6 factors were initially retained for males and 5 factors for females. Following varimax rotation, in the male sample Factor 5 was defined by two items, and Factor 6 was defined by only one item. In the female sample, Factor 5 was defined by two items. On this basis, four factors were retained for males and females separately, followed by varimax rotation.

In examining the differences in factor patterns for males and females, several particulars were observed. Males indicated more complex items (i.e., items loading on more than one factor) than did females. Males evidenced 11 items which

Table 20

Primary Factor Loadings for CARS Items Following a Principal Components Factor Analysis With an Orthogonal Rotation

Item	Factors 1	2	3	4	Communality
1	.67*	.38	-.04	.00	.60
2	.59*	.36	.13	.09	.51
3	.25	.71*	.12	.07	.60
4	.23	.11	.76*	.00	.65
5	.41*	.40	.17	.25	.42
6	.71*	.19	121	.00	.55
7	.43*	.46*	.21	.13	.45
8	.47*	.12	.57	.00	.57
9	.55*	.38	.16	.13	.50
10	.62*	.36	.10	.05	.53
11	.24	.65*	.21	-.08	.53
12	.59*	.16	.14	.08	.54
13	.19	.54*	02	.32	.44
14	.75*	.21	.08	.14	.65
15	.16	.61*	.03	.03	.40
16	.79*	.25	.12	.05	.71
17	-.02	.09	.76*	.19	.63
18	.71*	.10	.15	.17	.57
19	.73*	.39	.03	.05	.70

* Items loading .40 or higher

Table 20, continued

Item	Factors 1	2	3	4	Communality
20	.46*	.38	.08	.19	.41
21	.74*	.26	.02	.10	.63
22	.47*	.08	.10	.00	.24
23	.35	.71*	.08	.10	.64
24	.71*	.15	-.13	.01	.55
25	.69*	.35	.07	.10	.63
26	.53*	.50*	-.06	.15	.68
27	.09	-.02	.14	-.74*	.58
28	.74*	.22	.11	.21	.66
29	-.02	.45*	-.13	.60*	.59
30	.37	.16	.22	.47*	.44

* Items loading .40 or higher

loaded .40 or higher on two factors simultaneously, while females showed only 2 complex items. One item (#22) did not load on any of the factors for females. Another item (#25) loaded on three factors for males, and only one factor for females. The rotated factor pattern for females more closely resembled the total sample factor pattern. Factor loadings from these analyses are reported in Table 21.

Factor Structure

For the total CARS sample, variables (items) in the matrix with .40 or higher loadings on each of the four factors were collected and examined for unifying concepts. Loadings of variables on factors, communalities, and percents of variance are shown in Table 22. Variables were ordered and grouped by size of loading to facilitate interpretation, and loadings under .40 (i.e., 16% of variance) were replaced by zeros. Key words in each item were selected to assist in identifying concepts within the items, and are presented in the table. Interpretive labels have been suggested for each factor at the bottom of the columns. Factor 1 was identified as Comfortability, Factor 2 as Enjoyment, Factor 3 as Security, and Factor 4 as Rationality.

Items on Factor 1 appeared to reflect presence or absence of subjective feelings such as insecurity, nervousness, confidence, calmness, and confusion. Other items on Factor 1 had to do with avoidance of computers, jobs using computers,

Table 21

Primary Factor Loadings for CARS Items By Gender Following a Principal Components Factor Analysis With an Orthogonal Rotation

Item	Factors 1		2		3		4	
	M	F	M	F	M	F	M	F
1	.57	.74	.53					
2	.69	.51						
3			.67	.69				
4							.77	.72
5			.57			.43		
6	.73	.73						
7		.45	.48		.41			
8	.60	.43					.52	.56
9		.52	.57		.44			
10	.78	.58						
11			.68	.64				
12	.71	.69						
13			.69			.44		
14	.71	.77						
15			.45	.68				
16	.80	.79						
17							.62	.81
18	.77	.66						
19	.52	.81	.60					

Table 21, continued

Item	Factors 1 M	1 F	2 M	2 F	3 M	3 F	4 M	4 F
20	.51	.43	.41					
21	.64	.73						
22	.46				.60			
23				.69				
24	.64	.59						
25	.46	.75	.53		.42			
26	.48	.54	.55	.59				
27			.40			.64		
28	.64	.74			.41			
29			.55		.41	.68		
30					.56	.55		

Note: Only items loading .40 or higher are indicated
Female N = 222
Male N = 133

Table 22

Factor Loadings, Communalities (h2), Percents of Variance for Four-Factor Principal Factors Extraction, and Varimax Rotation on CARS Items

Item	Factors 1	2	3	4	h2
16. Insecure	.80	.00	.00	.00	.71
14. Nervous	.76	.00	.00	.00	.65
19. Confident	.74	.00	.00	.00	.70
21. Calm	.74	.00	.00	.00	.63
28. Confused	.74	.00	.00	.00	.66
6. Freeze up	.72	.00	.00	.00	.55
18. Complicated	.71	.00	.00	.00	.57
24. Appear dumb	.71	.00	.00	.00	.55
12. Panicky	.70	.00	.00	.00	.54
25. Easy	.70	.00	.00	.00	.63
1. Comfortable	.67	.00	.00	.00	.60
10. Avoid job	.62	.00	.00	.00	.53
2. Not the type	.59	.00	.00	.00	.51
9. Simple	.56	.00	.00	.00	.50
22. Worry/break	.48	.00	.00	.00	.24
20. Traditional	.47	.00	.00	.00	.41

Table 22, continued

Item	Factors 1	2	3	4	h2
5. Manageable	.41	.40	.00	.00	.42
3. Challenge	.00	.71	.00	.00	.60
23. Fascinating	.00	.71	.00	.00	.64
11. Enjoy gadgets	.00	.65	.00	.00	.53
15. "Best buddy"	.00	.61	.00	.00	.40
13. Involved	.00	.55	.00	.00	.44
26. Enjoy	.53	.51	.00	.00	.68
7. At ease	.43	.47	.00	.00	.45
4. Worry/jobs	.00	.00	.77	.00	.65
17. Replacement	.00	.00	.76	.00	.63
8. "Smart"	.48	.00	.58	.00	.57
27. Tools/human	.00	.00	.00	.74	.58
29. Take/course	.00	.00	.00	.61	.59
30. Let you down	.00	.00	.00	.48	.44
% of Variance	8.71	4.48	1.94	1.63	
Label	Comfortability	Enjoyment	Security	Rationality	

and feeling "not the type" to use computers. Factor 2 items reflected the challenge of using computers, finding computers "fascinating" and enjoyable, and personifying the computer as a "best buddy." Factor 3 items concerned worry about being replaced by computers and worry that computers were "too smart." Factor 4 items reflected a more rational approach to computers, recognition that computers are tools of humans, and a willingness to become more involved.

Predictors of Computer Anxiety

Forward selection and backward elimination regression procedures were conducted for the dependent variable of CARS total score. Four experience variables (word processing, data management, computer games, and financial management), as well as age and gender, were found to be significant predictors of level of computer anxiety. A stepwise regression procedure indicated experience in word processing was the largest contributor, accounting for 23% of the variance, followed by experience in data management with 6% of the variance. Experience in computer games, experience in financial management, and age each contributed 1% of the variance. Gender was a predictor at less than 1% of the variance. Table 23 shows the summary of the regression procedure.

Table 23

Summary of Stepwise Regression Procedure for Dependent Variable CARS

Variable Entered	% of Variance	Cummulative Variance	F Value	Pr > F
Word Processing	.225	.225	102.68	.0001
Data Management	.066	.292	33.17	.0001
Computer Games	.017	.309	9.01	.0029
Financial Management	.013	.323	6.81	.0094
Age	.011	.334	5.88	.0158
Gender	.008	.343	4.72	.0303

CHAPTER V
DISCUSSION, CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR RESEARCH

The infusion of microcomputers into an increasingly complex world has dramatically changed the ways information is managed, decisions are made, and learning takes place. However, emotional resistance to these changes has created the phenomenon of "computer anxiety." Therefore, the purpose of this study was to investigate this construct and determine the extent to which anxiety toward computers can be reliably and validly measured. More specifically, this study involved the development, refinement, and field testing of the Computer Anxiety Rating Scale (CARS).

A preliminary form (P-CARS) of the instrument was pilot tested and refined. The P-CARS was field tested initially with a sample of 256 students from a public and a private university in Florida. After revision, the final CARS was field tested with an additional 355 subjects from the same two institutions. The findings from the subsequent data analyses were presented in Chapter IV and are discussed in this chapter. The chapter includes generalizability of the study,

responses to the research questions, conclusions, and implications of the study for theory, training, research, and counseling practice. It concludes with recommendations for further research.

Generalizability

Efforts were made in the cluster sampling procedures to obtain students from the colleges of arts and science, business administration, and education in order to avoid the bias of academic major found in earlier studies. The final sample was composed of 37% arts and science majors, 33% business administration majors, and 30% education majors, thus avoiding this bias.

Additionally, effort was made to obtain a sample of students across college levels in order to obtain a broad range of age. The final sample was composed of 52% in the 17-22 age range, 24% in the 23-29 age range, 18% in the 30-39 age range, and 6% in the over age 40 group. This is an adequate representation of the combined universities, because Jacksonville University (JU) students are "traditional" in terms of age, and University of North Florida (UNF) students are generally older (i.e., non-traditional).

The student body of JU is approximately 49% male and 51% female; UNF is approximately 40% male and 60% female. The sample was comprised of 38% male and 62% female. A public and private university were sampled to investigate the possibility

of differences in populations. Because there were no significant differences in computer anxiety as measured by the CARS between the two groups of students, the sample consequently can be considered to be representative of the combined student bodies, and the results therefore generalizable to a broad range of university students. All subjects were volunteers, and students who did not wish to participate in the study were not required to do so. In addition, students who had participated in the first phase of the study were asked not to participate in the second phase. All instructors who agreed to have their classes participate were given standard procedures to follow in terms of instructions and testing conditions. It therefore can be assumed that no limits of generalizability were due to pretesting, reactive effects of experimental procedures, or multiple-treatment interference.

Responses to the Research Questions

What is the Factor Structure of the CARS?

A preliminary factor analysis of the P-CARS and a subsequent factor analysis of the CARS did not differ in critical findings. Intercorrelations of the items prior to the factor analyses indicated that many items were related to one another, and that a predictable overlap in factors would be revealed. For example, in both phases of the study Factors 1 and 2 were moderately correlated (.47 in phase 1 and .54 in phase 2), as were Factors 1 and 3 (.40 and .31, respectively).

Factors 1 and 4 (.39) and Factors 2 and 3 (.32) were related in the first phase of the study, and in the second phase, Factors 2 and 4 were correlated (.34). As indicated in Chapter IV, these correlations (resulting from an oblique rotation) indicated at least a 10% overlap in variance among the related factors.

As previously indicated, a decision was made subsequently to use an orthogonal rotation in order to "force" separation of the factors for interpretive purposes, although it was understood that many of the items of the instrument were in fact overlayed.

Only four items were eliminated from the P-CARS in a conservative response to the initial factor analysis, even though Factor 1 included several items which were highly intercorrelated and could possibly be considered redundant measures.

The last factor analysis of the CARS revealed 20 items clearly related to Factor 1 and 8 items related to Factor 2. In addition, although Factors 3 and 4 each contained only 3 items with salient loadings, the items appeared to be dissimilar from the items in Factors 1 and 2, and were therefore considered appropriately representative of separate factors. Consequently, the CARS was construed to be a four-factor instrument. As presented in Chapter IV, the factors were labeled Comfortability (level of comfort or discomfort with computers), Enjoyment (level of pleasure in using computers, Security (level of apprehension about being replaced by

computers), and Rationality (level of an detached or unemotional approach to using computers).

A comparison of these factors with the components of computer anxiety derived in Chapter III (p. 69) from a theoretical framework invites examination. The Comfortability Factor appears similar to Components I and III (Feelings of Unresolved Anxiety and Perceived Threat Responses), while the Security Factor appears similar to Component IV (Personification Responses). The initial outline of components included the perspective of measuring negative attitudes toward computers. The Enjoyment and Rationality Factors appear to be measuring negative attitudes, but in the context of measuring the <u>absense</u> of negative attitudes.

Factor analytic procedures were applied separately to the data for males and females, although the number of male subjects was considered marginal for valid results. Tabachnick and Fidell (1983) suggested that the number of subjects must be at least five times the number of variables (items) investigated. The results for males must therefore be interpreted with caution because of this limitation.

As presented in Chapter IV, males evidenced 10 items (#s 1,7,8,9,19,20,22,26,28, and 29) which loaded on two factors simultaneously and 1 item (#25) which loaded on three factors. Four items loaded on Comfortability and Enjoyment, 3 items

loaded on Enjoyment and Security, 1 item loaded on Comfortability and Rationality, and 1 item loaded on Comfortability, Enjoyment, and Security. Examination of the data indicated that in general these items received low anxiety responses from males.

Females evidenced only 2 complex items (i.e., loadings on more than one factor), and these were items which loaded on Comfortability and Enjoyment in one case (#8), and Comfortability and Rationality in the other (#26). Item #22 did not load on any factor for females, although it was the only highly loaded (.75) item on Factor 5 before the final factoring. This item was "I worry about breaking a computer by pushing the wrong keys." Possibly this item defines a separate factor for females, but does not appear as a significant item in a four-factor solution.

In summary, the CARS can be considered to have a four factor structure, with the first two factors most clearly defined and more easily interpreted.

What is the Reliability of the CARS?

The concept of reliability is typically defined using three assumptions (Walsh & Betz, 1985). The first assumption is that each subject assessed by an instrument has some fixed amount of the attribute of interest--known as the true score. The second assumption is that every score contains some degree of error. The third assumption is that any observed score

reflects both the true score and some degree of error. The individual CARS items may be considered reliable on this basis because the standard errors of measurement were relatively small, ranging from .04 to .06. The major source of error in test scores is time influence when scores taken at one point in time do not duplicate scores taken at another point in time. Test-retest reliability represents the stability of test scores over time upon repeated testings. Test-retest reliability of the P-CARS was .94 (2-week interval), while the reliability coefficient of the CARS was .83 (2-week interval), both significant at the .0001 level of confidence. Therefore, the CARS may be considered to be reliable over time.

Internal consistency is the extent to which a subject's score on one item is related to his/her score on all of the other items of an instrument, and is considered the reliability of homogeneity of the items. A Cronbach alpha coefficient of internal consistency was .94 on each form of the CARS, indicating a high measure of internal consistency.

In summary, the CARS may be considered to be a reliable instrument in terms of standard errors of measurement, test-retest reliability, and internal consistency.

<u>What is the Relationship Between Age and Computer Anxiety?</u>

Although age was not found to be significantly related to computer anxiety in Sample 1, there was a significant negative relationship between age and computer anxiety for

Sample 2. The second sample was comprised of 51.8% in the 17-22 age group, thereby lowering the mean age from 29 in Sample 1 to 25 in Sample 2. As will be discussed later in this chapter, experience with computers was found to be significantly related to level of computer anxiety. It may be assumed that the younger students have had less opportunity for "hands-on" experience with computers (with the exception of computer games), and are therefore more computer-anxious. Older students perhaps have had more opportunity for work experience where computers have been used, or have been exposed to computers in the university setting.

What is the Relationship Between Previous Computer Experience and Computer Anxiety

Subjects were asked to rate their experience with computers, relative to other students they knew, on a scale of 0 - 4, with 0 = very little experience and 4 = a great deal of experience. The five variables examined were experience with word processing, computer games, data management, financial management (e.g., taxes or banking), and statistical analyses. Little difference was observed between the two samples in terms of computer experience.

While experience in word processing, computer games, and data management were significantly related to computer anxiety, experience in financial management and statistical analyses were not. Very few subjects had a great deal of

experience in the latter variables, while many (69% in financial management and 64% in statistical analysis) had no or little experience. It may be assumed that the reason no relationship was found between these variables and computer anxiety is the lack of persons with adequate experience. It is reasonable to speculate that experience in and of itself on any of the variables would affect attitude toward computers, and that experience in word processing therefore was the most closely related variable because more of the sample (51.6%) had moderate to high levels of experience with word processing.

Although 46.5% of the subjects had a moderate to high level of experience with computer games, and only 25.9% had moderate to high experience with data management, computer games experience was not as closely related to computer anxiety. Presumably, computer games are of a special class of experience, and do not generate the same kind of familiarity with microcomputers as do other kinds of experiences. There was no differentiation in the demographic information between experience with games played on a microcomputer using a keyboard, and games played in a "games arcade." This may account for the fact that the amount of computer games experience did not have a significant relationship with computer anxiety.

Overall, an important finding of this study was that experience with computers was a better predictor of computer

anxiety (or lack of it) than either age or gender. While computer anxiety was found to be significantly related to the general anxiety trait (as measured by the STAI), and as such is theoretically not a learned anxiety, it also may be predicted that it is responsive to change with exposure (i.e., "hands-on") experience with computers.

What is the Difference in Computer Anxiety on the Basis of Gender?

Females scored significantly higher (p <.0001) in computer anxiety than did males on both forms of the instrument. Two speculations may be proffered for this difference. The first is that computers are commonly considered as "machinery," and many females are socialized to be less willing than males to familiarize themselves with mechanical objects. Item #11, "I enjoy playing with new technical gadgets," loaded on Factor 2 (Enjoyment) for both males and females, but females tended to score lower on this item.

The second conjecture is that one of the same mechanisms is at work in measurement of computer anxiety as has been found in measurement of math anxiety. As discussed in the literature in Chapter II, females tend to score higher in math anxiety than do males, although in the MARS sample for this study this trend was not significant. It might be assumed that the sample taking the MARS (primarily business majors) did not conform to the typical population for females in terms

of math anxiety. Some of the components of computer anxiety experienced by females nevertheless did exist within this sample.

What is the Difference in Computer Anxiety on the Basis of Academic Major

In Sample 1, 36 computer science majors were sampled separately for the purpose of establishing construct validity. It was assumed that students choosing a major in computer science would not typically express anxiety toward computers; therefore, students in a class in database processing and those in a class in computer data structures were asked to complete the P-CARS. As anticipated, computer science majors indicted a mean score (59.4) considerably lower than other majors (arts and science 83.7, education 80.7, and business 75.4). Differences among the groups were significant at the .0001 level of confidence. This result indicated that the P-CARS items were measuring, at least to some extent, the "construct" of computer anxiety.

In Sample 2, computer science majors were not sampled separately. Only 6 computer science majors were evidenced within the classes sampled, and their scores were included with the sample of arts and science majors.

Observations of their individual CARS scores were 41, 56, 60, 60, 61, and 98, for the most part well below the mean score (70.24) for the CARS. Although based on observation,

these figures support the findings from the first phase of the study regarding computer science majors.

In Sample 2, business majors scored significantly lower in computer anxiety than arts and science majors and education majors. Many of these subjects were students at the University of North Florida, where the mean age is 29, and where many students are already working while continuing their educations. It is reasonable to assume that these students have been exposed to microcomputers at an above-average frequency, thus contributing to their lower level of computer anxiety.

The following four research questions investigated support of criterion-related validity between the CARS and four instruments measuring constructs postulated to be related to the CARS. The instruments were administered concurrently with the CARS to independent subsamples. A major way of demonstrating relationships of this kind is through correlational data (Walsh & Betz, 1985), and in this study four such relationships were examined.

What is the Relationship between Computer Anxiety and Trait Anxiety?

As a basis for many scale development efforts, the STAI provided a logical framework for validation of a computer anxiety scale. Items for the A-Trait dimension only were used

because A-State items are designed to measure feelings of anxiety at a particular moment in time. Trait anxiety refers to relatively stable individual differences between persons in the tendency to respond to situations perceived as threatening with raised anxiety.

The CARS had a significant positive relationship with the A-Trait scale of the STAI, indicating a strong relationship between computer anxiety and trait anxiety. Consequently, it can be assumed that computer anxiety (as measured by the CARS) shares with the construct of trait anxiety a reaction to a wider range of threatening situations. Circumstances in which an individual's personal adequacy is threatened have been found to relate to high A-Trait. Therefore, just as the A-Trait scale has been used to select subjects who vary in their disposition to respond to psychological stress, the CARS may be useful in identifying persons who do not "appear" anxious, but who are more likely to experience anxiety with initial exposure to computer-related tasks.

A major difference in A-Trait and computer anxiety may be the concept of stability over time. A-Trait anxiety has been found to be relatively stable even throughout fluctuations in A-State anxiety (Spielberger et al., 1970). The results of the CARS study showed that students who had more experience with computers showed less computer anxiety. Therefore, it may be inferred that initially anxious students

would present reduced computer anxiety following computer experience.

It can be concluded that the significant relationship between the CARS and the STAI provided evidence of the concurrent validity of the CARS in measuring an aspect of general trait anxiety.

What is the Relationship between Computer Anxiety and Math Anxiety?

Computer anxiety and math anxiety were found to be significantly related in this study. The developers of the MARS at first considered it to be a measurement of a unidimensional construct. However, later researchers identified three factors in math anxiety: evaluation anxiety, arithmetic computation anxiety, and social responsibility anxiety. Although this study did not investigate relationship to the MARS by separate factors, it is interesting to speculate that computer anxiety might be related to the aspect of social responsibility, as well as to math anxiety in general.

What is the Relationship Between Computer Anxiety and Test Anxiety

Although test anxiety was found by Spielberger (1980) to be only moderately correlated with the A-Trait scale of the STAI for males, it was more highly correlated with the A-State scale for females, and on this basis could not be definitively classified as a measure of either trait or state anxiety.

Spielberger considered test anxiety to be a situation-specific personality trait, however. In the current study test anxiety did not correlate significantly with computer anxiety. In fact, only four items on the CARS were significantly related to the measure of test anxiety. Three of the four items loaded on Factor 1 (Comfortability), and 1 item loaded on Factor 4 (Rationality) of the CARS. Test anxiety is typically construed to be a learned reaction, and as such, may not relate to computer anxiety as part of the general anxiety construct.

What is the Relationship Between Computer Anxiety and Locus of Control?

No significant relationship was found between computer anxiety and locus of control. Only six CARS items were significantly related to the I-E scale. As discussed in Chapter II, previous studies have shown internal-external locus of control (as a situation-specific expectancy) to be a reliable predictor of attitudes toward computers; however, no previous studies were found which related locus of control to the anxiety directed toward use of computers. Four of the six items of the CARS were significantly related to the I-E, and loaded on Factor 2 (Enjoyment) of the CARS, and 2 items loaded on Factor 1 (Comfortability). Consequently, on the basis of this study, computer anxiety had no relationship with locus on control.

Conclusions

Conclusions About the Instrument

The CARS was developed, refined, and field tested with samples totaling 689 college students. The 30-item instrument measures anxiety toward microcomputers, may be administered individually or in groups, and has a seventh-grade reading level.

The CARS was found to have four factors: Comfortability, Enjoyment, Security, and Rationality. The Comfortability factor reflected presence or absence of subjective feelings such as insecurity, nervousness, confidence, calmness, and confusion, as well as indication of avoidance of computers or jobs using computers. The Enjoyment factor reflected presence or absence of the challenge of using computers. The Security factor primarily concerned worry about computers replacing persons in the workplace, and worry that computers were "too smart." The Rationality factor was concerned with a logical approach to use of computers, and a willingness to become more involved.

The CARS had excellent reliability over time for the full scale, and also was found to have high internal consistency.

The establishment of validity of the CARS included examination of information pertinent to content validity, criterion-related validity, and construct validity. An early effort to establish content validity included the use of

consultants to review the initial item pool following careful construction of the items. Examination of the comments of the developmental sample helped to refine further the content of the items. Finally, content validity was indirectly evaluated through the degree to which the CARS showed high internal consistency reliability, or homogeneity of the items. Content validation was the essential first step in the establishment of the CARS' validity.

Criterion-related validity was established by the concurrent administration of additional instruments as well as the prediction of CARS score from demographic information of students in the samples. The examination of the difference between CARS scores of computer science majors and other students provided an initial examination of constuct validity, based on the assumption that computer science majors would evidence less anxiety toward computers. Additionally, factor analyses provided support for construct validity of the CARS. Several factors were found to be in (partial) agreement with the assumed dimensionality of the initial construct developed from the literature (as discussed in Chapter IV).

Conclusions About the Results

The CARS differentiated between responses by gender and by academic major. Females indicated more anxiety toward microcomputers than did males in both samples. As anticipated, computer science majors were considerable less anxious

than other students, and in the second sample, business administration majors were less anxious than either arts and sciences majors or education majors.

In addition, the CARS indicated that younger students were more computer anxious than older students, a result not anticipated from initial readings in the literature. It was concluded that older college students potentially have had more opportunity for "hands-on" experience with computers in both work environments and academic settings than do younger students.

Experience with computers was the primary predictor of level of computer anxiety as measured by the CARS, in particular experience in word processing.

The CARS was significantly related to A-Trait anxiety as measured by the STAI, and math anxiety as measured by the MARS. Contrarily, it was not related to test anxiety, as measured by the TAI, or locus of control, as measured by the I-E Scale.

Implications

The development of the CARS provides useful information in the areas of theory, training, research, and practice of counseling. The first major conclusion and associated implication is that computer anxiety can be measured using the CARS. Moreover, measurement of computer anxiety adds yet

another specific manifestation of measurement of components of the general construct of anxiety.

The implication for training consists of provision of the CARS for counselor-trainees and/or others (e.g., teachers) to have experience in yet another counseling tool. In addition, counselor training programs may be able to use the CARS as a resource for students to assess their own computer anxiety and thus aid in making decisions regarding preparation for computer-assisted academic requirements (e.g., computer statistical research).

In addition, the instrument may be used in future research to measure the extent of computer anxiety, as well as the effectiveness of subsequent counseling interventions (e.g., computer anxiety reduction). In counseling practice, professionals may be able to use the CARS to measure the extent of computer specific anxiety, and if appropriate, work to help clients reduce computer anxiety.

Suggestions for Further Research

Potential exists for continued analysis of the large amounts of existing data, particularly in the areas of interaction between demographic information as it relates to the CARS. Because both age and gender were found to be related to computer anxiety, further exploration should be made of the interaction between age, gender, and CARS scores. Likewise, interactions between college major and age, and

college major and gender also should be explored for effects on computer anxiety. In addition, data on computer experience should be explored further to clarify which experience variables are most related to age, gender, and college major.

In addition to analysis of the existing data, research is needed to further refine the CARS (e.g., eliminating redundant items), and increase clarification of the factor structure. A revised CARS could be administered to a new sample for this purpose, as well as to obtain a larger sample for test-retest purposes. The main purpose of such research would be to develop a form of the CARS which yields maximum information from a minimum number of items.

The factor structure of the CARS by gender also should be explored further using a larger sample. Because the factor structure of an instrument is more clearly defined by use of very large samples, a larger sample would serve to allow further refinement of the differences noted between males and females in this study.

In regard to refinement of the factors in general, creation and field testing of additional items related to Factors 3 and 4 may assist in further definition of these factors. Although three items are considered adequate in definition of a factor (Gorsuch, 1974), the CARS could be more balanced in terms of less items loading on the respective factors.

Additional studies also may serve to clarify the relationship between the CARS and math anxiety because the sample chosen for the MARS subgroup was inadvertently composed of primarily business administration majors. Previous study has found math anxiety to be a contributor to computer anxiety for females; this aspect could be explored further in additional investigation.

In the future, other reference groups, such as high school students and community college students, as well as other samples of university students, could be used for the purpose of norming the CARS. Such scores on the CARS could then be standardized for ease of interpretation.

Further research also should be conducted to develop other items in order to create a second form of the instrument. Separate, but closely related forms would be especially useful in measuring treatment effects on computer anxiety reduction.

Summary

This study attempted to further define and measure the construct of computer anxiety, the emotional resistance influenced by the appearance of micro-computer technology. The Computer Anxiety Rating Scale has been developed and validated in order to assist in this measurement, and thus allow identification of and assistance to computer-anxious persons.

Zefran (1984, p. 19) wrote:

> In 1902 Sigmund Freud began a minor revolution in the science of human behavior; in 1974, the small computer began a minor revolution in the science of information management. . . . The revolutionary aspect of Freud's work did not arise so much from a new burst of knowledge; knowledge of human behavior existed before Freud. Rather, the Freudian revolution arose from the fact that knowledge of human behavior could be used in new ways and for a wider group of people. In the same way, the revolutionary aspect of the small computer is that the power of the computer is now available to be used in new ways and for a wider group of people.

The challenge facing those in the helping professions is to introduce the "power of the computer" without the interference of needless resistance and anxiety.

APPENDIX A

PRELIMINARY FORM OF THE CARS

COMPUTER ATTITUDE SURVEY

PRELIMINARY FORM

DEAR STUDENT,

THE INFORMATION BEING GATHERED IN THIS SURVEY WILL BE USED TO ASSIST IN DEVELOPMENT OF A MEASURE OF ATTITUDES TOWARDS COMPUTERS. PLEASE HELP WITH THIS PROJECT BY ANSWERING EACH ITEM IN THE QUESTIONNAIRE.

YOUR RESPONSES WILL BE KEPT ANONYMOUS -- YOU NEED NOT PUT YOUR NAME ON THE FORM OR THE ANSWER SHEET. DEMOGRAPHIC DATA FROM THE INFORMATION FORM WILL BE USED ONLY TO ORGANIZE GROUP RESPONSES TO THE QUESTIONNAIRE. **FOLLOWING THE QUESTIONNAIRE YOU WILL BE ASKED TO COMPLETE SOME ITEMS REGARDING THE QUESTIONNAIRE ITSELF.** YOUR ANSWERS WILL BE HELPFUL IN MAKING THE QUESTIONNAIRE MORE CLEAR AND COMPLETE. YOUR COOPERATION IS GREATLY APPRECIATED.

THANK YOU,

Jo Brooke

INFORMATION FORM

1. What is your gender? (Please check one)

   Male______ Female______

2. What is your present age? ______

3. What is your academic major? (If you have not yet declared a major, please indicate your best prediction of the major you will choose.) ________________________

4. How much experience have you had with personal computers? (Please check one)

   None at all ______

   Very little ______

   A moderate amount ______

   A great deal ______

COMPUTER ATTITUDE SURVEY

<u>DIRECTIONS</u>: Read each of the following statements carefully and then blacken the appropriate space on your answer sheet to indicate how you <u>generally</u> feel regarding computers. There are no right or wrong answers. If a statement seems not to apply to you at the present time, answer according to how it might apply to you at some future time. Please make only <u>one</u> response to each statement.

Strongly Disagree = 1
Disagree = 2
Uncertain = 3
Agree = 4
Strongly Agree = 5

1.	I would feel comfortable using a computer.	1	2	3	4	5
2.	The more I use a computer, the more confused I am.	1	2	3	4	5
3.	I feel fairly confident about using a computer.	1	2	3	4	5
4.	Someday in the future, computers will be running our lives for us	1	2	3	4	5
5.	I would be panicky if I had to use a computer for any reason	1	2	3	4	5
6.	Computers don't make sense to me . . .	1	2	3	4	5
7.	I have a lot of self confidence when it comes to using a computer.	1	2	3	4	5
8.	One of these days all our jobs will be done by computer.	1	2	3	4	5
9.	Having to use a computer would make me very nervous	1	2	3	4	5
10.	Using a computer makes me feel nervous and confused	1	2	3	4	5
11.	I would feel all right about solving a problem with computers.	1	2	3	4	5
12.	We have to be careful computers don't replace people	1	2	3	4	5

13. Thinking about having to use a computer makes me nervous. 1 2 3 4 5

14. There is too much to learn about computers to remember it all. 1 2 3 4 5

15. I know I am no good at using computers. . 1 2 3 4 5

16. There is no limit to what computers can do 1 2 3 4 5

17. I get nervous just thinking about learning to use a computer 1 2 3 4 5

18. Computers are much too complicated. . . 1 2 3 4 5

19. I am not the type to do well with computers 1 2 3 4 5

20. Computers have become so "smart" they are sort of strange and frightening . . 1 2 3 4 5

21. The challenge of solving problems with computers appeals to me. 1 2 3 4 5

22. Sometimes when I use a computer I get so frustrated I quit 1 2 3 4 5

23. I think using a computer would be very hard for me. 1 2 3 4 5

24. They have gone too far with computers. . 1 2 3 4 5

25. I can't help feeling anxious when it comes to computers 1 2 3 4 5

26. I freeze up in front of a computer. . . 1 2 3 4 5

27. I am afraid of appearing foolish if I try to use a computer 1 2 3 4 5

28. Computers almost have minds of their own. 1 2 3 4 5

29. I wish computers did not bother me so much. 1 2 3 4 5

30. When I try to use a computer, sometimes I can't remember where to start. . . . 1 2 3 4 5

31. I am afraid I would look dumb if I tried to learn to use a computer. . 1 2 3 4 5

32. Computers can make important decisions better than people can. 1 2 3 4 5

33. I feel very tense when I have to use a computer 1 2 3 4 5

34. Using a computer is simple and clearcut to me 1 2 3 4 5

35. I would feel at ease in a class which teaches using a computer 1 2 3 4 5

36. You can't argue with a computer. . . . 1 2 3 4 5

37. I don't plan to get involved in learning to use a computer 1 2 3 4 5

38. Computers are fascinating and fun . . . 1 2 3 4 5

39. Sometimes you can't trust a computer . . 1 2 3 4 5

40. I would prefer to do as little work with computers as possible 1 2 3 4 5

41. I enjoy computers 1 2 3 4 5

42. A computer will let you down more often than not. 1 2 3 4 5

43. I would never take a job where I had to use computers. 1 2 3 4 5

44. I will never use a computer again if I can help it. 1 2 3 4 5

45. Computers and I just don't get along . . 1 2 3 4 5

46. I would like to take a course about using computers 1 2 3 4 5

47. I would like to try using a computer . . 1 2 3 4 5

48. I would rather get things done regular ways than to learn to computerize them . 1 2 3 4 5

FEEDBACK FORM

1. In general, the wording of the questions was

   clear______ unclear______

2. What specific questions, if any, were unclear to you?

   ____

3. What suggestions do you have that would make these questions more clear to you? ____________________

   ____

4. Did you find any of the questions difficult to answer?

   Yes______ No ______

5. Which questions, if any, were difficult to answer?______ ____________ Why? ____________________

   ____

6. In general, the format of the questionnaire was

   easy to follow ______ difficult to follow ______

7. What, if anything, would have made the format easier to follow? ____________________

8. In your own experience, or in considering your feelings regarding computers, are there any other questions that could be included in this survey? Yes ______ No______

   If yes, what are they? ____________________

   ____

Please add any additional comments you may wish to make on the back of this page.

APPENDIX B

DEVELOPMENTAL STUDY

INDEX OF COMPUTER ANXIETY:

A DEVELOPMENTAL STUDY

In test construction, the reliability and validity of an instrument are evaluated after the test is constructed. However, if careful and proper methods are used in the development process, the chances are increased that the test will be found to be reliable and valid.

A desirable approach to test construction includes administration of the items to a preliminary sample of subjects, often referred to as the "developmental sample" (Walsh & Betz, 1985, p. 70). Responses obtained from this sample are used to refine the item pool by either eliminating, adding, or rewording items in order to constitute a test with the desired elements.

In order to refine the initial pool of 48 items written for the Computer Anxiety Rating Scale (CARS), a study was conducted prior to the main research study. This preliminary study consisted of selection of a sample, administration of the instrument, and analysis of the results.

Developmental Sample Selection

Three groups of subjects were chosen for inclusion in the developmental study. They were considered to be representative of the subsequent larger samples to be selected for purposes of studying reliability and validity of the instrument.

Group I was composed of 26 students enrolled in an "educational methods" class at a state university (University of North Florida) in northern Florida. Group II included 34 students enrolled in an introductory psychology class at a private university (Jacksonville University) in northern Florida. The subjects chosen for Group III were 18 members of a class in business marketing at the private university. These classes were chosen in order to designate students among the three academic colleges of arts and sciences, business administration, and education. For purposes of this research, the institutions involved in the study are identified as University A (the state university) and University B (the private university). Participation of all subjects was voluntary.

A selection of class groups across academic colleges was made in an attempt to avoid academic major bias in the sampling procedures. Two institutions were sampled in order to further avoid bias. The instrument was administered to groups of subjects, rather than to individuals, for ease of

accessibility of large numbers of subjects and for greater potential of avoiding individual selection bias.

Resulting sample

The preliminary form of the CARS was administered to a total of 78 persons. Completion of all items, including the demographic data, was the criterion for an informal analysis, and all 78 questionnaires were acceptable on this basis. The resulting sample included 25 students with a major in the college of arts and science, 29 with a major in the college of business administration, and 24 with a major in the college of education. The mean age of the total sample was 23, with a median age of 30. Twenty-two of the subjects were male, and 57 were female. These figures represent over-sampling of the female population because University A reports a ratio of 44.39% male to 55.70% female, and University B reports a 49.49%/50.51% ratio.[1] Four students indicated no experience with computers, 35 indicated very little experience, 36 indicated moderate experience, and 3 students indicated a great deal of experience. The breakdown for the overall sample is presented in Table B1. Tables B2 and B3 present the breakdown by institution.

Methodology

Students in the selected classes were asked to voluntarily complete the CARS, including demographic information

Table B1

Major, Age, Gender, and Previous Computer Experience--Developmental Sample

Demographic Variable	Frequency (f)	Percentage (%)
Major by College		
Arts and Science	25	32.05
Business	23	29.49
Education	30	38.46
Total	78	100.00
Age		
18-22	57	73.08
23-29	8	10.25
30-39	10	12.82
Over 40	3	3.85
Total	78	100.00
Gender		
Male	21	26.93
Female	57	73.07
Total	78	100.00
Previous Computer Experience		
None at all	4	5.13
Very little	35	44.87
Moderate amount	36	46.15
A great deal	3	3.85
Total	78	100.00

Table B2

Major, Age, Gender, and Previous Computer Experience--Developmental Sample, University of North Florida

Demographic Variable	Frequency (f)	Percentage (%)
Major by College		
Arts and Science	1	3.85
Business	0	0.00
Education	25	96.15
Total	26	100.00
Age		
18-22	8	30.77
23-29	5	19.23
30-39	10	38.46
Over 40	3	11.54
Total	26	100.00
Gender		
Male	0	0.00
Female	26	100.00
Total	26	100.00
Previous Computer Experience		
None at all	3	11.54
Very little	14	53.85
Moderate amount	8	30.77
A great deal	1	3.84
Total	26	100.00

Table B3

Major, Age, Gender, and Previous Computer Experience--Developmental Sample, Jacksonville University

Demographic Variable	Frequency (f)	Percentage (%)
Major by College		
Arts and Science	24	46.15
Business	23	44.23
Education	5	9.62
Total	52	100.00
Age		
18-22	49	94.23
23-29	3	5.77
30-39	0	0.00
Over 40	0	0.00
Total	52	100.00
Gender		
Male	21	40.38
Female	31	59.62
Total	52	100.00
Previous Computer Experience		
None at all	1	1.92
Very little	21	40.38
Moderate amount	28	53.85
A great deal	2	3.85
Total	52	100.00

and a feedback form. In each instance, the class instructor or the researcher read the directions for the CARS aloud to the class, and asked if there were any questions concerning the questionnaire. Subjects were instructed to complete the demographic items, to place their responses to the items on an optically-scanned answer sheet, and to respond to the feedback form. The average time for administration was 15 minutes.

Results

A review of the feedback form completed by subjects in the developmental sample indicated that 71 persons felt the questionnaire items were clear, while 7 felt the items were unclear. Reasons given for lack of clarity pertained to verb tense of the items. Three out of 78 subjects felt some items were difficult to answer because of the subjects' lack of computer experience, or because wording of the questions assumed lack of computer experience. Four persons suggested a reversal of the response format, preferring Strongly Agree as the first response choice.

Thirty-two (41%) of the total subjects suggested the questionnaire was long, and that items were redundant; that many appeared to be asking the same question. Four persons suggested asking if the respondents owned a computer, and two persons said the questions assumed that the respondents were negative toward computers.

Following administration of the CARS to the initial developmental sample, two faculty members expert in psychometric construction were consulted. They also suggested shortening the CARS and rewording several of the items to offer improved face validity of the items with the subcomponents of computer anxiety. One consultant recommended rewording the items to provide equal balance among positive and negative items.

Initial Item Analysis

Based upon feedback from the developmental sample and suggestions of the two consultants, a decision was made to shorten the questionnaire, and to reword several of the remaining items. In order to facilitate this refinement, two statistical procedures were conducted. Means and standard deviations of the 48 items were calculated, and are reported in Table B4. The mean scores for each item ranged from 1.87 to 3.33, with the average of all means being 2.34. Intercorrelations of the items were also calculated, and are reported in Table B5.

One item from each of the 16 subcomponents of computer anxiety was eliminated on the basis of the intercorrelations. Four pairs of items remained unchanged, and were correlated at significance levels of .0001, .05, .002, and .01 respectively. A number of items also were reworded to provide more balance between positively and negatively worded items. After

Table B4

Mean and Standard Deviation of Preliminary CARS Items

Item	Mean	SD	Item	Mean	SD
1	2.13	1.07	25	2.47	1.04
2	2.21	.96	26	1.95	.82
3	2.51	1.15	27	2.24	1.03
4	2.94	1.19	28	2.56	1.16
5	2.05	1.08	29	2.26	1.04
6	2.17	1.02	30	2.86	1.19
7	3.05	1.02	31	2.13	1.01
8	2.47	1.18	32	2.23	1.04
9	2.10	.95	33	2.17	1.10
10	2.14	.99	34	3.26	1.02
11	2.42	.92	35	2.50	.98
12	3.00	1.27	36	3.33	1.20
13	2.18	1.09	37	2.09	1.04
14	2.69	1.02	38	2.40	1.09
15	2.41	1.02	39	2.80	1.07
16	3.18	1.18	40	2.44	1.12
17	2.08	.94	41	2.63	1.15
18	2.35	1.02	42	2.21	.86
19	2.32	1.08	43	1.95	1.01
20	2.10	.93	44	1.87	.92
21	2.58	1.00	45	2.08	.92
22	2.77	1.19	46	2.15	1.01
23	2.13	.88	47	2.05	.95
24	1.91	.87	48	2.39	1.07

Table B5

Intercorrelations of Preliminary Items 1-48

Item	1	2	3	4	5	6	7	8
1	--							
2	.64**	--						
3	.73**	.68**	--					
4	.34	.30	.33	--				
5	.53**	.52**	.53**	.15	--			
6	.58**	.68**	.60**	.31	.60**	--		
7	.58**	.52**	.74**	.25	.39*	.50**	--	
8	.35	.22	.25	.41*	.06	.21	.22	--
9	.58**	.57**	.61**	.21	.59**	.61**	.47**	.25
10	.59**	.64**	.61**	.27	.62	.59**	.51**	.28
11	.64**	.56**	.59**	.16	.58**	.53**	.59**	.37
12	.21	.12	.19	.14	.11	.16	.18	.20
13	.56**	.60**	.58**	.30	.54**	.86**	.52**	.26
14	.23	.18	.20	.10	.23	.24	.31	.03
15	.59**	.42*	.60**	.22	.46**	.55**	.44**	.38*
16	.01	-.07	.06	.15	.00	.15	.10	.13
17	.49**	.49**	.46**	.25	.51**	.72**	.40	.26
18	.36*	.33	.38*	.08	.31	.56**	.35	.23
19	.59**	.52**	.55**	.39*	.43**	.72**	.47**	.25
20	.49**	.43**	.41*	.33	.38*	.44**	.29	.28
21	.35	.44**	.43**	-.01	.41*	.40*	.26	.07
22	.26	.27	.36*	.18	.34	.20	.31	.08
23	.55**	.58**	.64**	.23	.63**	.62**	.51**	.14
24	.35	.29	.311	.02	.36*	.37*	.24	.18

* $p < .001$ ** $p < .0001$

Table B5, continued

Item	9	10	11	12	13	14	15	16
1								
2								
3								
4								
5								
6								
7								
8								
9	--							
10	.84**	--						
11	.59**	.66**	--					
12	.21	.10	.17	--				
13	.69**	.72**	.49**	.25	--			
14	.31	.26	.17	.27	.31	--		
15	.65**	.60**	.50**	.50**	.24	.38*	--	
16	.16	.07	.08	.02	.16	.11	.21	--
17	.72**	.70**	.46**	.24	.75**	.21	.51**	.23
18	.45**	.39*	.33	.00	.52**	.33	.45**	.33
19	.64**	.62**	.41*	.28	.71**	.37*	.66**	.22
20	.50**	.42**	.43**	.35	.47**	.36*	.39*	.23
21	.25	.26	.32	.02	.32	.32	.37*	.13
22	.27	.26	.21	.10	.18	.27	.33	-.26
23	.69**	.66**	.47**	.22	.66**	.40*	.67**	.05
24	.47**	.39*	.39*	.13	.37	.19	.36*	.17

* $p < .001$ ** $p < .0001$

Table B5, continued

Item	17	18	19	20	21	22	23	24
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17	--							
18	.57**	--						
19	.72**	.51**	--					
20	.39*	.34	.55**	--				
21	.22	.46**	.26	.21	--			
22	.17	.11	.28	.13	.31	--		
23	.61**	.40*	.70**	.50**	.44**	.51**	--	
24	.37*	.28	.36*	.49**	.28	.13	.52**	--

* $p < .001$ ** $p < .0001$

Table B5, continued

Item	1	2	3	4	5	6	7	8
25	.26	.23	.24	.25	.23	.44**	.26	.22
26	.51**	.44**	.50**	.29	.56**	.43**	.33	.27
27	.44**	.39*	.40*	.22	.44*	.41*	.43**	.30
28	.23	.23	.21	.19	.11	.19	.29	.46**
29	.46**	.38*	.43**	.16	.49**	.45**	.39*	.21
30	.28	.36*	.37*	.02	.28	.25	.51**	.07
31	.49**	.31	.40*	.13	.43**	.46**	.45**	.38*
32	.16	.14	.16	.06	.16	.35	.06	.19
33	.58**	.47**	.54**	.26	.52**	.60**	.54**	.29
34	.36*	.40*	.38*	.13	.26	.31	.53**	.12
35	.56**	.43**	.50**	.12	.58**	.54**	.35	.25
36	−.09	.03	−.04	.09	−.15	−.12	.12	.20
37	.44**	.50**	.46**	.20	.31	.47**	.27	.22
38	.41*	.47**	.46**	.18	.37*	.37*	.32	.09
39	.10	.07	.11	−.15	.19	.13	.25	−.05
40	.42**	.42**	.44**	.15	.38*	.42**	.26	.15
41	.48**	.40*	.45**	.12	.40*	.35	.25	.10
42	.41*	.58**	.34	−.05	.33	.45**	.34	.20
43	.42**	.28	.25	.08	.55**	.40*	.15	.04
44	.48**	.44**	.37*	.11	.61*	.51**	.26	.13
45	.51**	.59**	.53**	.23	.66*	.62**	.42**	.18
46	.28	.32	.29	.15	.23	.34	.16	.13
47	.40	.34	.32	.27	.44**	.51**	.21	.28
48	.43*8	.54**	.40	.21	.42**	.47**	.34	.34

* $p < .001$. ** $p < .0001$.

Table B5, continued

Item	9	10	11	12	13	14	15	16
25	.33	34*	.14	.34	.45**	.31	.30	.11
26	.62**	.54**	.55**	.29	.49**	.26	.49**	.09
27	.58**	.52**	.46**	.22	.46**	.33	.47**	.14
28	.20	.18	.18	.24	.29	.14	.12	.23
29	.47**	.50**	.39*	.23	.51**	.20	.45**	.00
30	.40*	.36	.34	.10	.27	.34	.25	-.07
31	.58**	.54**	.56**	.20	.49**	.33	.49**	.09
32	.26	.21	.12	.22	.29	.18	.22	.15
33	.68**	.66**	.52**	.24	.65**	.38*	.60**	.06
34	.29	.31	.36**	.03	.31	.33	.29	-.12
35	.48**	.53**	.51**	.12	.40*	.33	.61**	.02
36	-.10	-.08	-.07	.06	-.05	.04	-.21	-.11
37	.33	.30	.22	.31	.38*	.31	.41*	-.04
38	.28	.42**	.39*	.02	.24	.23	.41*	-.11
39	.07	.13	.22	.28	.11	.10	.17	-.14
40	.31	.31	.35	.18	.32	.23	.35	.01
41	.34	.34	.38*	.12	.30	.20	.42**	.18
42	.40*	.41*	.48**	.05	.39	.37*	.43**	-.04
43	.41*	.32	.33	.16	.29	.25	.44**	.06
44	.46**	.44**	.42**	.28	.45**	.23	.46**	.07
45	.53**	.54**	.48**	.23	.55**	.41*	60**	.05
46	.15	.16	.20	.20	.26	.27	.27	-.05
47	.47**	.42**	.41*	.25	.49**	.28	.59**	.06
48	.46**	.43**	.45**	.24	.41*	.35	.42	.03

* $p < .001$ ** $p < .0001$

Table B5, continued

Item	17	18	19	20	21	22	23	24
25	.48**	.26	.43**	.26	.03	.11	.33	.26
26	.50**	.26	.49**	.60**	.24	.31	.65**	.54**
27	.50**	.30	.52**	.58**	.21	.20	.55**	.49**
28	.17	.17	.25	.41*	-.08	-.13	.09	.15
29	.49**	.29	.35*	.41*	.24	.27	.60**	.37*
30	.14	.09	.29	.30	.12	.31	.43**	.11
31	.46**	.35*	.45**	.57**	.20	.25	.55**	.51**
32	.34	.24	.34	.42**	.04	.02	.36*	.27
33	.61**	.41*	.61**	.55**	.35*	.40*	.67**	.42
34	.22	.00	.28	.16	.25	.41*	.39	.20
35	.48**	.41*	.44**	.31	.50**	.36*	.49**	.40*
36	-.13	-.13	-.06	-.08	-.22	.07	-.16	-.13
37	.27	.16	.42**	.39*	.34	.45*	.55**	.39
38	.15	.11	.30	.20	.36	.47**	.45**	.38
39	.09	.05	.07	.23	.01	.11	.25	.12
40	.23	.20	.35	.24	.51**	.42**	.48**	.39*
41	.24	.24	.25	.17	.63**	.30	.40*	.35*
42	.24	.31	.35	.32	.34	.25	.48**	.30
43	.38*	.18	.42**	.41*	.33	.35	.53**	.45**
44	.45**	.16	.40*	.41*	.39	.35	.63**	.54**
45	.52**	.28	.54**	.37*	.58**	.50**	.73**	.41*
46	.15	.06	.24	.20	.39*	.27	.28	.28
47	.45**	.21	.48**	.39*	.24	.42**	.54**	.46**
48	.36*	.27	.42**	.40*	.42**	.32	.45**	.44**

* $p < .001$ ** $p < .0001$

Table B5, continued

Items	25	26	27	28	29	30	31	32
25	--							
26	.30	--						
27	.35	.55**	--					
28	.20	.28	.23	--				
29	.32	.44**	.53	.04	--			
30	.06	.32	.40*	.19	.15	--		
31	.27	.59**	.76**	.27	.62**	.35	--	
32	.28	.30	.23	.30	.25	.11	.40*	--
33	.34	.57**	.73**	.15	.70**	.39*	.74**	.23
34	.10	.28	.34	.08	.23	.38*	.35	-.13
35	.34	.42**	.48**	-.34	.45**	.13	.54**	.09
36	.08	-.19	-.00	.18	-.13	.29	-.10	.03
37	.16	.45**	.28	.19	.22	.21	.42**	.36*
38	.08	.32	.25	-.08	.21	.18	.28	.00
39	.11	.02	.20	.04	.29	.14	.23	.11
40	.14	.39*	.40*	-.07	.33	.27	.40*	-.01
41	.09	.35	.22	-.07	.21	.01	.19	-.09
42	.15	.35	.35	.10	.26	.40*	.37*	.21
43	.21	.53**	.46**	-.09	.37*	.09	.44**	.20
44	.17	.61**	.39*	.08	.40*	.11	.48**	.27
45	.31	.54**	.47**	.01	.44**	.31	.49**	.25
46	.13	.20	.13	-.01	.10	-.05	.17	.11
47	.29	.49**	.42**	.00	.39*	.14	.51**	.26
48	.23	.39	.50**	.11	.30	.35	.45**	.07

* $p < .001$ ** $p < .0001$

Table B5, continued

Items	33	34	35	36	37	38	39	40
25								
26								
27								
28								
29								
30								
31								
32								
33	--							
34	.40*	--						
35	.51**	.32	--					
36	-.07	-.05	-.03	--				
37	.32	.34	.47**	-.18	--			
38	.26	.41*	.45**	-.22	.49**	--		
39	.21	.00	.17	-.08	.14	.18	--	
40	.44**	.44**	.53**	-.16	.59**	.59**	.12	--
41	.26	.43**	.48**	-.34	.45**	.61**	-.02	.66**
42	.39*	.31	.37*	-.02	.35	.37*	.27	.32
43	.44**	.24	.66**	-.27	.49**	.39*	.22	.46**
44	.46**	.29	.57**	-.38*	.63**	.47**	.22	.51**
45	.62**	.45**	.70	-.19	.60**	.53**	.20	.58**
46	.21	.24	46**	-.15	.61**	.50**	.07	.49**
47	.53**	.27	.53**	-.16	.49**	.48	.16	.39
48	.56**	.43**	.58**	-.04	.43**	.32	.07	.60**

* $p < .001$ ** $p < .0001$

Table B5, continued

Items	41	42	43	44	45	46	47	48
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41	--							
42	.21	--						
43	.38*	.28	--					
44	.45**	.36*	.77**	--				
45	.50**	.52**	.65**	.76**	--			
46	.42**	.32	.44**	.58**	.55**	--		
47	.31	.42*	.59**	.68**	.69**	.60**	--	
48	.40*	.51**	.45**	.50**	.50**	.34	.41*	--

* p < .001 ** p < .0001

rewording, each subcomponent contained one item designed to measure presence of computer anxiety and one item designed to measure absence of computer anxiety.

At the suggestion of one of the psychometric consultants, a change was made in the directions on the first page of the CARS in order to clarify the definition of a computer. Since computers exist in many varities, the directions clarified that the questionnaire referred to personal computers.

In addition, a subcomponent which was brought to the attention of the researcher by a faculty member who teaches research was added to the outline of components of computer anxiety. This subcomponent is known as fear of technology, and appears as an element of Unresolved Anxiety. Jay (1981) related hostile or aggressive thoughts concerning personal computers to resistance to computer technology.

Dambrot, Watkins-Malek, Silling, Marshall, and Garver (1985) found that resistance to computer technology was expressed partially by fear of touching a computer, or fear of damaging the computer or stored data. Kennedy (1988) pointed out that "computerphobes" (i.e., those having a fear or dread of the computer) derive their fear from two possible sources: an overall fear of technology, and a fear of breaking or "blowing up" the computer.

Finally, the five response choices on the instrument were reversed to read Strongly Agree, Agree, Uncertain, Disagree,

and Strongly Disagree with corresponding weights of 1 through 5. The revised outline of components of computer anxiety, along with the remaining items reflecting each, appears in Table 2 of Chapter III. The resulting 34 items are provided in Appendix C, which includes an introductory statement and revised demographic items. Together, they comprise Form 1 of the CARS.

[1] Figures were taken from the University Statistical Abstract, 1988, University of North Florida (University A), and information from the Office of the Registrar, Jacksonville University (University B).

APPENDIX C

P-CARS

COMPUTER ATTITUDE SURVEY

DEAR STUDENT,

THE INFORMATION BEING GATHERED IN THIS SURVEY WILL BE USED TO ASSIST IN DEVELOPMENT OF A MEASURE OF ATTITUDES TOWARD COMPUTERS. PLEASE HELP WITH THIS PROJECT BY ANSWERING EACH ITEM IN BOTH QUESTIONNAIRES.

YOUR RESPONSES WILL BE KEPT ANONYMOUS -- YOU NEED NOT PUT YOUR NAME ON THE FORMS OR EITHER OF THE ANSWER SHEETS. DEMOGRAPHIC DATA FROM THE INFORMATION FORM WILL BE USED ONLY TO ORGANIZE GROUP RESPONSES TO THE QUESTIONNAIRES.

YOUR ANSWERS WILL BE HELPFUL IN MAKING THE QUESTIONNAIRE MORE CLEAR AND COMPLETE. YOUR COOPERATION IS GREATLY APPRECIATED.

1. Please complete the Information Form.
2. Complete the Computer Attitude Survey, using the appropriate answer sheet.

THANK YOU

Jo Brooke

INFORMATION FORM

1. What is your gender? (Please check one)

   Male ______ Female ______

2. What is your present age? ______

3. What is your academic major? (If you have not yet declared a major, please indicate your best prediction of the major you will choose.) ____________________

4. Compared to other students you know, please rate your experience with computers on a scale of 0 - 4, with

   0 = none or very little
   1 = less than average
   2 = an average amount
   3 = more than average
   4 = a great deal

   Word Processing ______

   Computer Games ______

   Data Management ______

   Financial Management ______

   Statistical Analyses ______

COMPUTER ATTITUDE SURVEY

DIRECTIONS: Read each of the following statements carefully and then blacken the appropriate space on your answer sheet to indicate how you generally feel regarding computers. There are no right or wrong answers. If a statement seems not to apply to you at the present time, answer according to how it might apply to you at some future time. Please make only one response to each statement.

Strongly Agree = 1
Agree = 2
Uncertain = 3
Disagree = 4
Strongly Disagree = 5

1.	I would feel comfortable using a computer	1	2	3	4	5
2.	I am not the type to do well with computers	1	2	3	4	5
3.	The challenge of solving problems with computers appeals to me	1	2	3	4	5
4.	I worry that one of these days all our jobs will be done by computer	1	2	3	4	5
5.	My attitude toward computers is that they are quite manageable.	1	2	3	4	5
6.	I freeze up in front of a computer . .	1	2	3	4	5
7.	I would feel at ease in a class which teaches using a computer	1	2	3	4	5
8.	Computers have become so "smart" they are sort of strange and frightening . .	1	2	3	4	5
9.	Using a computer is simple and clearcut to me	1	2	3	4	5
10.	I would avoid a job where I had to use computers	1	2	3	4	5
11.	I enjoy playing with new technical gadgets	1	2	3	4	5
12.	I would be panicky if I had to use a computer for any reason	1	2	3	4	5
13.	As far as computers are concerned, "garbage in, garbage out" is accurate .	1	2	3	4	5
14.	I get nervous just thinking about learning to use a computer	1	2	3	4	5

		SD	D	U	A	SA
15.	A computer can be almost a "best buddy" .	1	2	3	4	5
16.	I feel insecure about using a computer .	1	2	3	4	5
17.	I don't think there is any danger that computers will ever replace people . .	1	2	3	4	5
18.	Computers are much too complicated for me	1	2	3	4	5
19.	I feel confident about using a computer .	1	2	3	4	5
20.	I would rather get things done regular ways than to learn to computerize them .	1	2	3	4	5
21.	I worry about breaking a computer by pushing the wrong keys	1	2	3	4	5
22.	I am taking some steps to get more involved in using a computer	1	2	3	4	5
23.	The ability to use computers is highly overrated	1	2	3	4	5
24.	Computers are fascinating and fun	1	2	3	4	5
25.	I am afraid of appearing dumb if I try to use a computer	1	2	3	4	5
26.	Using a computer is easy for me	1	2	3	4	5
27.	I think that computers reason better than people	1	2	3	4	5
28.	I feel reasonably calm when using a computer	1	2	3	4	5
29.	I do not enjoy computers	1	2	3	4	5
30.	I wish computers did not bother me so much	1	2	3	4	5
31.	Computers are wonderful tools, but only the tools of humans	1	2	3	4	5
32.	Using a computer makes me feel confused .	1	2	3	4	5
33.	I would like to take a course about using computers	1	2	3	4	5
34.	A computer will let you down more often than not	1	2	3	4	5

APPENDIX D

CARS

COMPUTER ATTITUDE SURVEY

DEAR STUDENT,

THE INFORMATION BEING GATHERED IN THIS SURVEY WILL BE USED TO ASSIST IN DEVELOPMENT OF A MEASURE OF ATTITUDES TOWARD COMPUTERS. PLEASE HELP WITH THIS PROJECT BY ANSWERING EACH ITEM IN BOTH QUESTIONNAIRES.

YOUR RESPONSES WILL BE KEPT ANONYMOUS -- YOU NEED NOT PUT YOUR NAME ON THE FORMS OR EITHER OF THE ANSWER SHEETS. DEMOGRAPHIC DATA FROM THE INFORMATION FORM WILL BE USED ONLY TO ORGANIZE GROUP RESPONSES TO THE QUESTIONNAIRES.

YOUR ANSWERS WILL BE HELPFUL IN MAKING THE QUESTIONNAIRE MORE CLEAR AND COMPLETE. YOUR COOPERATION IS GREATLY APPRECIATED.

1. Please complete the Information Form.
2. Complete the Computer Attitude Survey, using the appropriate answer sheet.
3. Complete the second questionnaire, using the second appropriately marked answer sheet.

THANK YOU

Jo Brooke

INFORMATION FORM

1. What is your gender? (Please check one)

   Male ______ Female ______

2. What is your present age? ______

3. What is your academic major? (If you have not yet declared a major, please indicate your best prediction of the major you will choose.) ______________________

4. Compared to other students you know, please rate your experience with computers on a scale of 0 - 4, with

   0 = none or very little
   1 = less than average
   2 = an average amount
   3 = more than average
   4 = a great deal

   Word Processing ______

   Computer Games ______

   Data Management ______

   Financial Management ______

   Statistical Analyses ______

Computer Attitude Survey

<u>DIRECTIONS</u>: Read each of the following statements carefully and then blacken the appropriate space on your answer sheet to indicate how you <u>generally</u> feel regarding computers. There are no right or wrong answers. If a statement seems not to apply to you at the present time, answer according to how it might apply to you at some future time. Please make only <u>one</u> response to each statement.

Strongly Agree = 1
Agree = 2
Uncertain = 3
Disagree = 4
Strongly Disagree = 5

1.	I would feel comfortable using a computer	1	2	3	4	5
2.	I am not the type to do well with computers	1	2	3	4	5
3.	The challenge of solving problems with computers appeals to me	1	2	3	4	5
4.	I worry that one of these days all our jobs will be done by computer	1	2	3	4	5
5.	My attitude toward computers is that they are quite manageable.	1	2	3	4	5
6.	I freeze up in front of a computer . .	1	2	3	4	5
7.	I would feel at ease in a class which teaches using a computer	1	2	3	4	5
8.	Computers have become so "smart" they are sort of strange and frightening . .	1	2	3	4	5
9.	Using a computer is simple and clearcut to me	1	2	3	4	5
10.	I would avoid a job where I had to use computers	1	2	3	4	5
11.	I enjoy playing with new technical gadgets	1	2	3	4	5
12.	I would be panicky if I had to use a computer for any reason	1	2	3	4	5

		SD	D	U	A	SA
13.	I am taking some steps to get more involved in using a computer. . . .	1	2	3	4	5
14.	I get nervous just thinking about learning to use a computer	1	2	3	4	5
15.	A computer can be almost a "best buddy" .	1	2	3	4	5
16.	I feel insecure about using a computer .	1	2	3	4	5
17.	I don't think there is any danger that computers will ever replace people . .	1	2	3	4	5
18.	Computers are much too complicated for me	1	2	3	4	5
19.	I feel confident about using a computer .	1	2	3	4	5
20.	I would rather do things in traditional ways than learn to computerize them . .	1	2	3	4	5
21.	I feel reasonably calm when using a computer	1	2	3	4	5
22.	I worry about breaking a computer by pushing the wrong keys	1	2	3	4	5
23.	Computers are fascinating and fun . . .	1	2	3	4	5
24.	I am afraid of appearing dumb if I try to use a computer	1	2	3	4	5
25.	Using a computer is easy for me . . .	1	2	3	4	5
26.	I do not enjoy computers	1	2	3	4	5
27.	Computers are wonderful tools, but only the tools of humans	1	2	3	4	5
28.	Using a computer makes me feel confused .	1	2	3	4	5
29.	I would like to take a course about using computers	1	2	3	4	5
30.	A computer will let you down more often than not	1	2	3	4	5

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BIOGRAPHICAL SKETCH

Jo Ann Brooke (nee Beard) was born in Charlottesville, Virginia, and completed her secondary education in Staunton, Virginia. She received the degree of Bachelor of Arts, magna cum laude, from Mary Baldwin College in Staunton, Virginia, in 1958, with a major in philosophy and a minor in English literature. While in college she was active in student government.

After graduation she joined the staff of the Social Services Department in Waynesboro, Virginia, as a social worker. Ms. Brooke subsequently worked in the Office of the Provost at The University of the South in Sewanee, Tennessee, and then in Poughkeepsie, New York, where she was employed in the public school system as a substitute teacher in art. Her daughters, Robin and Anne, were born in 1962 and 1964.

In 1972, Ms. Brooke moved with her daughters to Jacksonville, Florida, to pursue study in the helping professions. She completed requirements for a Bachelor of Science degree in psychology from Jacksonville University in 1974, and received a Master of Arts degree in counseling psychology from the University of North Florida in 1975.

After graduate school she joined the staff of the Academic Enrichment and Skills Center at the University of

North Florida as a tutor in writing and statistics, and subsequently filled the positions of Administrative Assistant and Assistant Director of the Center. In 1979, Ms. Brooke accepted a position as staff counselor in the Counseling and Testing Center at the university. She was licensed as a Mental Health Counselor in the state of Florida in 1982.

In 1983 Ms. Brooke entered the University of Florida's doctoral program in counselor education. At the University of North Florida, she assumed the title of University Counseling Psychologist in 1985. She also has a private practice in counseling and has served as a consultant to community agencies and businesses. She is a member of the Florida Society of Clinical Hypnosis and the American Association of Counseling and Development. Her professional interests include applications of clinical hypnosis, uses of metaphor in counseling, and microcomputers in counseling.

Ms. Brooke enjoys writing, underwater photography, sailing, and flying. She holds a private pilot's license in gliders and became the first female member of the North Florida Soaring Society in 1973. Her future plans include continued employment in the university setting, teaching, and time to pursue her major hobbies.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Larry C Loesch

Larry C. Loesch, Chair
Professor of Counselor Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert J. Drummond
Professor of Counselor Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Gerardo M. Gonzalez
Associate Professor of Counselor Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cheryl A. Fountain

Cheryl A. Fountain
Associate Professor of Educational Leadership

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1989

David E. Smith

Dean, College of Education

Dean, Graduate School